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## 1.0 PROJECT OBJECTIVES

The project objective is to design and construct facilities for the military that are consistent with the design and construction practices used for civilian sector projects that perform similar functions to the military projects. For example, a Company Operations Facility has the similar function as an office/warehouse in the civilian sector; therefore the design and construction practices for a company operations facility should be consistent with the design and construction of an office/warehouse building.

### Comparison of Military Facilities to Civilian Facilities

Military Facility	Civilian Facility
Aircraft Hangar	Paint Spray Hangar

It is the Army's objective that these buildings will have a 25-year useful design life before a possible re-use/re-purpose or renovation requirement, to include normal sustainment, restoration, modernization activities and a 50-year building replacement life. Therefore, the design and construction should provide an appropriate level of quality to ensure the continued use of the facility over that time period with the application of reasonable preventive maintenance and repairs that would be industry-acceptable to a major civilian sector project OWNER. The site infrastructure will have at least a 50-year life expectancy with industry-accepted maintenance and repair cycles.

The project site should be developed for efficiency and to convey a sense of unity or connectivity with the adjacent buildings and with the Installation as a whole.

Requirements stated in this contract are minimums. Innovative, creative, and life cycle cost effective solutions, which meet or exceed these requirements are encouraged. Further, the OFFEROR is encouraged to seek solutions that will expedite construction (panelization, pre-engineered, etc.) and shorten the schedule. **The intent of the Government is to emphasize the placement of funds into functional/operational requirements. Materials and methods should reflect this by choosing the lowest Type of Construction allowed by code for this occupancy/project allowing the funding to be reflected in the quality of interior/exterior finishes and systems selected.**

### 1.1. SECTION ORGANIZATION

This Section is organized under 6 major "paragraphs".

- (1) Paragraph 1 is intended to define the project objectives and to provide a comparison between the military facility(ies) and comparable "civilian" type buildings.
- (2) Paragraph 2 describes the scope of the project.
- (3) Paragraph 3 provides the functional, operational and facility specific design criteria for the specific facility type(s) included in this contract or task order.
- (4) Paragraph 4 lists applicable industry and government design criteria, generally applicable to all facility types, unless otherwise indicated in the Section. It is not intended to be all-inclusive. Other industry and government standards may also be used, where necessary to produce professional designs, unless they conflict with those listed.
- (5) Paragraph 5 contains Army Standard Design Criteria, generally applicable to all facility types, unless otherwise indicated in the Section.
- (6) Paragraph 6 contains installation and project specific criteria supplementing the other 5 paragraphs.

## 2.0 SCOPE OF PROJECT

2.1 F-22 HANGAR BAY LO/CR FACILITY: This project will construct a third F-22 LO/CR Hangar Bay Addition on the existing LO/CR Facility Building No. 361. The existing facility consists of an F-22 LO/CR Washrack, two F-22 LO/CR paint spray Hangar Bays, and Ancillary Spaces which is comprised of administrative, locker spaces, and shop space for inspection and restoration of aircraft surfaces, and daily workflow.

The new hangar bay is to be 1,205 square meters (SM). This addition includes the paint spray hangar bay, supporting ancillary spaces, mechanical, electrical, and communications rooms. Utilities will be connected to the existing base utilities in the vicinity. The existing hangar bays are constructed on pile foundations and it is anticipated that pile foundations will also be required for this addition. Exterior architectural appearance will match the existing hangars and all AT/FP requirements will be met.

The existing spaces are critical to base's mission and the construction of the new facility can not interrupt or interfere with operations in the existing hangar bays or encroach on the aircraft access apron to the existing hangar bays. The existing access apron is to be kept clean at all times.

The air handlers for the existing hangar bays require 100% makeup air and are very energy inefficient. Therefore, the new hangar bay will be required to use only 20% makeup air, thus reducing energy impact of temperature and humidity control.

The interior area requirements for this project were determined using the Lockheed Martin/Boeing Facilities Requirement Plan dated Nov 2007 and as specified in Air Force Handbook 32-1084, "Facility Requirements".

Conceptual floor plans are located in Appendix J. They were developed from the Pre RFP Development Charrette and are based on the criteria above, the needs of the user, and the required functional relationships. It is submitted as a concept. It can be modified, but only after approval from the user through the Contracting Officer. A conceptual Inter Relationship Diagram is also provided in Appendix KK.

2.1.1 PRICED OPTIONS: The project includes six (6) Priced Options:

a. Option 1: Security for Existing LO/CR Hangar Bays: Provide security for the primary entry doors to the two existing LO/CR Hangar Bays as described in Section 01 10 00, Paragraph 6.9, Subparagraph 6.9.15

b. Option 2: Mass Notification System throughout Existing Building 361: Under the basic requirements of this RFP, a new mass notification system is required for the new LO/CR Hangar Bay. This Option is to extend that new mass notification system throughout the existing Building 361 to include all hangar bays, washrack and ancillary and support spaces as described in Section 01 10 00, Paragraph 6.13, Subparagraph 6.13.2.4

- c. Option 3: In lieu of LEED Fundamental Commissioning, provide LEED Enhanced Commissioning as described in Section 01 10 00, Paragraph 6.14, Subparagraph 6.14.8.3.2
- d. Option 4: Provide LEED Measurement and Verification as described in Section 01 10 00, Paragraph 6.14, Subparagraph 6.14.8.4
- e. Option 5: Provide a new water meter on the existing domestic water service entering Building 361, Room 118 as described in Section 01 10 00, Paragraph 6.8, Subparagraph 6.8.6
- f. Option 6: Provide a geothermal heat pump system to supply heating, cooling, ventilation and air conditioning for the new areas supporting the Paint Hangar Composite Repair Process as described in Section 01 10 00, Paragraph 6.11, Subparagraph 6.11.1.10

2.1.2 APPENDICES ATTACHED TO THIS RFP: All Appendices attached to this RFP are considered an integral part of this document and apply to this RFP regardless of whether they are referenced within the body of the RFP or not.

## 2.2. SITE:

Provide all site improvements necessary to support the new building facilities. Refer to Paragraph 6.

Approximate area available 3.28 acres

## 2.3. GOVERNMENT-FURNISHED GOVERNMENT-INSTALLED EQUIPMENT (GFGI)

Coordinate with Government on GFGI item requirements and provide suitable structural support, brackets for projectors/VCRs/TVs, all utility connections and space with required clearances for all GFGI items. Fire extinguishers are GF/GI personal property, while fire extinguisher brackets and cabinets are Contractor furnished and installed CF/CI. All Computers and related hardware, copiers, faxes, printers, video projectors, VCRs and TVs are GFGI.

The following are also GFGI items: No Additional Requirements in this section

## 2.4. FURNITURE REQUIREMENTS

Provide furniture design for all spaces listed in Chapter 3 and including any existing furniture and equipment to be re-used. Coordinate with the user to define requirements for furniture systems, movable furniture, storage systems, equipment, any existing items to be reused, etc. Early coordination of furniture design is required for a complete and usable facility.

The procurement and installation of furniture is NOT included in this contract. Furniture will be provided and installed under a separate furniture vendor/installer contract. The general contractor shall accommodate that effort with allowance for entry of the furniture vendor/installer onto this project site at the appropriate time to permit completion of the furniture installation for a complete and usable facility to coincide with the Beneficial Occupancy Date (BOD) of this project. The furniture vendor/installer contract will include all electrical pre-wiring and the whips for final connection to the building electrical systems however; the general contractor shall make the final connections to the building electrical systems under this contract. Furthermore, the general contractor shall provide all Information/Technology (IT) wiring (i.e. LAN, phone, etc.) up to and including the face plate of all freestanding and/or systems furniture desk tops as applicable, the services to install the cable and face plates in the furniture, the coordination with the furniture vendor/installer to accomplish the installation at the appropriate time, and all the final IT connections to the building systems under this contract.

The Government reserves the right to change the method for procurement of and installation of furniture to Contractor Furnished/Contractor Installed (CF/CI). CF/CI furniture will require competitive open market procurement by the Contractor using the Furniture, Fixtures and Equipment (FF&E) package.

## 2.5. NOT USED

**3.0 FACILITY SPECIFIC REQUIREMENTS:** See detailed facility requirements in Paragraph 6 of this specification section.

**4.0 APPLICABLE CRITERIA**

Unless a specific document version or date is indicated, use criteria from the most current references as of the date of issue of the contract or task order, including any applicable addenda, unless otherwise stated in the task order. In the event of conflict between References and/or Applicable Military Criteria, apply the most stringent requirement, unless otherwise specifically noted in the contract or task order.

**4.1. INDUSTRY CRITERIA**

Applicable design and construction criteria references are listed in Table 1 below. This list is not intended to include all criteria that may apply or to restrict design and construction to only those references listed. See also Paragraph 3 for additional facility-specific applicable criteria.

**Table 1: Industry Criteria**

<b>Air Conditioning and Refrigeration Institute (ARI)</b>	
ARI 310/380	Packaged Terminal Air-Conditioners and Heat Pumps
ARI 440	Room Fan-Coil and Unit Ventilator
ANSI/ARI 430-99	Central Station Air Handling Units
ARI 445	Room Air-Induction Units
ARI 880	Air Terminals
<b>Air Movement and Control Association (AMCA)</b>	
AMCA 210	Laboratory Methods of Testing Fans for Rating
<b>American Architectural Manufacturers Association (AAMA)</b>	
AAMA 605	Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 607.1	Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum
AAMA 1503	Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections
<b>American Association of State Highway and Transportation Officials (AASHTO)</b>	
	Roadside Design Guide [guardrails, roadside safety devices]
	Standard Specifications for Transportation Materials and Methods of Sampling and Testing [Road Construction Materials]

	Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
	Guide for Design of Pavement Structures, Volumes 1 and 2 [pavement design guide]
	A Policy of Geometric Design of Highways and Streets
<b>American Bearing Manufacturers Association (AFBMA)</b>	
AFBMA Std. 9	Load Ratings and Fatigue Life for Ball Bearings
AFBMA Std. 11	Load Ratings and Fatigue Life for Roller Bearings
<b>American Boiler Manufacturers Association (ABMA)</b>	
ABMA ISEI	Industry Standards and Engineering Information
<b>American Concrete Institute</b>	
ACI 302.2R	Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
ACI 318	Building Code Requirements for Structural Concrete
ACI SP-66	ACI Detailing Manual
ACI 530	Building Code Requirements for Masonry Structures
<b>ADA Standards for Accessible Design</b>	
See US Access Board	ADA and ABA Accessibility Guidelines for Buildings and Facilities, Chapters 3-10.
<b>American Institute of Steel Construction (AISC)</b>	
	Manual of Steel Construction – 13 <sup>th</sup> Edition (or latest version)
<b>American Iron and Steel Institute</b>	
AISI S100	North American Specification for the Design of Cold-Formed Steel Structural Members
<b>American National Standards Institute 11 (ANSI)</b>	

ANSI Z21.10.1	Gas Water Heaters Vol. 1, Storage water Heaters with Input Ratings of 75,000 Btu per Hour or less
ANSI Z124.3	American National Standard for Plastic Lavatories
ANSI Z124.6	Plastic Sinks
ANSI Z21.45	Flexible Connectors of Other Than All-Metal Construction for Gas Appliances
ANSI/IEEE C2-2007	National Electrical Safety Code
ANSI/AF&PA NDS-2001	National Design Specification for Wood Construction
<b>American Society of Civil Engineers (ASCE)</b>	
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASCE 37	Design and Construction of Sanitary and Storm Sewers, Manuals and Reports on Engineering Practice [sanitary sewer and storm drain design criteria]
ASCE/SEI 31-03	Seismic Evaluation of Existing Buildings [Existing Building Alteration/Renovation]
ASCE/SEI 41-06	Seismic Rehabilitation of Existing Buildings [Existing Building Alteration/Renovation]
<b>American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)</b>	
ASHRAE 90.1	ANSI/ASHRAE/IESNA 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE Guideline 0	The Commissioning Process
ASHRAE Guideline 1.1	The HVAC Commissioning Process
ASHRAE Handbooks	Fundamentals, HVAC Applications, Systems and Equipment, Refrigeration (Applicable, except as otherwise specified)
ASHRAE Standard 15	Safety Standard for Refrigeration Systems
ASHRAE Standard 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE Standard 55	Thermal Environmental Conditions for Human Occupancy (Design portion is applicable)



<b>American Society of Mechanical Engineers International (ASME)</b>	
ASME BPVC SEC VII	Boiler and Pressure Vessel Code: Section VII Recommended Guidelines for the Care of Power Boilers
ASME A17.1	Safety Code for Elevators and Escalators
ASME B 31 (Series)	Piping Codes
<b>American Water Works Association (AWWA)</b>	
	Standards [standards for water line materials and construction]
<b>American Welding Society</b>	
	Welding Handbook
	Welding Codes and Specifications (as applicable to application, see International Building Code for example)
<b>Architectural Woodwork Institute (AWI)</b>	
Version 1.2	AWI Quality Standards 7th Edition
<b>Associated Air Balance Council (AABC)</b>	
AABC MN-1	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems
	AABC Associated Air Balance Council Testing and Balance Procedures
<b>ASTM International</b>	
ASTM C1060-90(1997)	Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings
ASTM E 779 (2003)	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
ASTM E1827-96(2002)	Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
<b>Builders Hardware Manufacturers Association (BHMA)</b>	
ANSI/BHMA	American National Standards for Builders Hardware

<b>Building Industry Consulting Service International</b>	
	Telecommunications Distribution Methods Manual (TDMM)
	Customer-Owned Outside Plant Design Manual (CO-OSP)
<b>Code of Federal Regulations (CFR)</b>	
49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
10 CFR 430	Energy Conservation Program for Consumer Products
<b>Consumer Electronics Association</b>	
CEA 709.1B	Control Network Protocol Specification
CEA 709.3	Free-Topology Twisted-Pair Channel Specification
CEA 852	Tunneling Component Network Protocols Over Internet Protocol Channels
<b>Electronic Industries Association (EIA)</b>	
ANSI/EIA/TIA 568	Structured Cabling Series
ANSI/EIA/TIA 569	Commercial Building Standard for Telecommunications Pathways and Spaces (includes ADDENDA)
ANSI/TIA/EIA-606	Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings
J-STD EIA/TIA 607	Commercial Building Grounding and Bonding Requirements for Telecommunications
<b>Federal Highway Administration (FHWA)</b>	
	Manual on Uniform Traffic Control Devices for Streets and Highways [signage and pavement markings for streets and highways]
FHWA-NHI-01-021	Hydraulic Engineering Circular No. 22, Second Edition, URBAN DRAINAGE DESIGN MANUAL
<b>Illuminating Engineering Society of North America (IESNA)</b>	
IESNA RP-1	Office Lighting

IESNA RP-8	Roadway Lighting
IESNA Lighting Handbook	Reference and Application
<b>Institute of Electrical and Electronics Engineers Inc. (IEEE)</b>	
	Standard for Use of the International System of Units (SI): the Modern Metric System
Standard 1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
<b>International Code Council (ICC)</b>	
IBC	<p>International Building Code</p> <p>Note: All references in the International Building Code to the International Electrical Code shall be considered to be references to NFPA 70.</p> <p>All references in the International Building Code to the International Fuel Gas Code shall be considered to be references to NFPA 54 and NFPA 58.</p> <p>All references in the International Building Code to the International Fire Code and Chapter 9 shall be considered to be references to Unified Facilities Criteria (UFC) 3-600-01.</p>
IMC	<p>International Mechanical Code –</p> <p>Note: For all references to “HEATING AND COOLING LOAD CALCULATIONS”, follow ASHRAE 90.1</p> <p>Note: For all references to “VENTILATION”, follow ASHRAE 62.1</p>
IRC	International Residential Code
IPC	International Plumbing Code
IEC	Energy Conservation Code (IEC) –Applicable only to the extent specifically referenced herein. Refer to Paragraph 5, ENERGY CONSERVATION requirements.
IGC	International Gas Code - not applicable. Follow NFPA 54, National Fuel Gas Code and NFPA 58, Liquefied Petroleum Gas Code.
<b>International Organization for Standardization (ISO)</b>	
ISO 6781:1983	Qualitative detection of thermal irregularities in building envelopes –

	infrared method
<b>LonMark International (LonMark)</b>	
LonMark Interoperability Guidelines	(available at <a href="http://www.lonmark.org">www.lonmark.org</a> ), including: Application Layer Guidelines, Layer 1-6 Guidelines, and External Interface File (XIF) Reference Guide
LonMark Resource Files	(available at <a href="http://www.lonmark.org">www.lonmark.org</a> ), including Standard Network Variable Type (SNVT) definitions
<b>Metal Building Manufacturers Association (MBMA)</b>	
	Metal Building Systems Manual
<b>Midwest Insulation Contractors Association (MICA)</b>	
	National Commercial and Industrial Insulation Standards Manual
<b>National Association of Corrosion Engineers International (NACE)</b>	
NACE RP0169	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0185	Extruded, Polyolefin Resin Coating Systems with Adhesives for Underground or Submerged Pipe
NACE RP0285	Corrosion Control of Underground Storage Tank Systems by Cathodic Protection
NACE RP0286	Electrical Isolation of Cathodically Protected Pipelines
<b>National Electrical Manufacturers Association (NEMA)</b>	
<b>National Environmental Balancing Bureau (NEBB)</b>	
	Procedural Standards Procedural Standards for Testing Adjusting Balancing of Environmental Systems
<b>National Fire Protection Association (NFPA)</b>	
NFPA 10	Standard for Portable Fire Extinguishers
NFPA 13	Installation of Sprinkler Systems
NFPA 13R	Residential Occupancies up to and Including Four Stories in Height Sprinkler Systems

NFPA 14	Standard for the Installation of Standpipes and Hose Systems
NFPA 20	Installation of Centrifugal Fire Pumps
NFPA 24 NFPA 25	Standard for the Installation of Private Fire Service Mains and Their Appurtenances [underground fire protection system design]  Inspection, Testing And Maintenance Of Water-Based Fire Protection Systems
NFPA 30	Flammable and Combustible Liquids Code
NFPA 30A	Motor Fuel Dispensing Facilities and Repair Garages
NFPA 31	Installation of Oil Burning Equipment
NFPA 54	National Fuel Gas Code
NFPA 58	Liquefied Petroleum Gas Code
NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm Code
NFPA 76	Fire Protection of Telecommunications Facilities
NFPA 80	Standard for Fire Doors and Fire Windows
NFPA 90a	Installation of Air Conditioning and Ventilating Systems
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
NFPA 101	Life Safety Code
NFPA 780	Standard for the Installation of Lightning Protection Systems
<b>National Roofing Contractor's Association (NRCA)</b>	
	Roofing and Waterproofing Manual
<b>National Sanitation Foundation, International</b>	
NSF/ANSI Std. 2, 3, 4, 5, 6, 7, 8, 12, 13, 18, 20, 21, 25, 29, 35, 36, 37, 51, 52, 59,	Food Equipment Standards

169	
ANSI/UL Std. 73, 197, 471, 621, 763	Food Equipment Standards
CSA Std. C22.2 No. 109, 120, 195	Food Equipment Standards
<b>Occupational Safety and Health Administration (OSHA)</b>	
Title 29, Part 1926	OSHA Construction Industry Standards, Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction
<b>Plumbing and Drainage Institute (PDI)</b>	
PDI G 101	Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data
PDI WH201	Water Hammer Arrestors
<b>Precast Concrete Institute</b>	
PCI Design Handbook	Precast and Prestressed Concrete
<b>Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)</b>	
SMACNA HVAC Duct Construction Standards	HVAC Duct Construction Standards - Metal and Flexible
SMACNA Architectural Manual	Architectural Sheet Metal Manual
SMACNA HVAC TAB	HVAC Systems - Testing, Adjusting and Balancing
<b>State/Local Regulations</b>	
	State Department of Transportation Standard Specifications for Highway and Bridge Construction
	Sedimentation and Erosion Control Design Requirements
	Environmental Control Requirements
	Storm Water Management Requirements
<b>Steel Door Institute (SDI)</b>	

ANSI A250.8/SDI 100	Standard Steel Doors and Frames
<b>Steel Deck Institute</b>	
	SDI Diaphragm Design Manual
<b>Steel Joist Institute</b>	
	Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders
<b>Underwriters Laboratories (UL)</b>	
UL 96A	Installation Requirements for Lightning Protection Systems
UL 300	Standard for Safety for Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas
<b>UNITED STATES ACCESS BOARD: U.S. ARCHITECTURAL AND TRANSPORTATION BARRIERS COMPLIANCE BOARD</b>	
ADA and ABA Accessibility Guidelines for Buildings and Facilities	<p>ABA Accessibility Standard for DoD Facilities</p> <p>Derived from the ADA and ABA Accessibility Guidelines: Specifically includes: ABA Chapters 1 and 2 and Chapters 3 through 10.</p> <p>Use this reference in lieu of IBC Chapter 11.</p> <p>Excluded are:</p> <p>(a) Facilities, or portions of facilities, on a military installation that are designed and constructed for use exclusively by able-bodied military personnel (See Paragraph 3 for any reference to this exclusion).</p> <p>(b) Reserve and National Guard facilities, or portions of such facilities, owned by or under the control of the Department of Defense, that are designed and constructed for use exclusively by able-bodied military personnel. (See paragraph 3 for any reference to this exclusion).</p>
<b>U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES</b>	
	FDA National Food Code
<b>U.S. GREEN BUILDING COUNCIL (USGBC)</b>	
LEED-NC	Green Building Rating System for New Construction & Major Renovations
	Application Guide for Multiple Buildings and On-Campus Building Projects

## 4.2. MILITARY CRITERIA

The project shall conform to the following criteria. Certain design impacts and features due to these criteria are noted for the benefit of the offeror. However, all requirements of the referenced criteria will be applicable, whether noted or not, unless otherwise specified herein.

4.2.1. Energy Policy Act of 2005 (Public Law 109-58) (applies only to the extent specifically implemented in the contract, which may or may not directly cite or reference EPACT)

4.2.2. Executive Order 12770: Metric Usage In Federal Government

(a) Metric design and construction is required except when it increases construction cost. Offeror to determine most cost efficient system of measurement to be used for the project.

4.2.3. TB MED 530: Occupational and Environmental Health Food Sanitation

4.2.4. Unified Facilities Criteria (UFC) 3-410-01FA: Heating, Ventilating, and Air Conditioning - applicable only to the extent specified in paragraph 5, herein.

4.2.5. Deleted.

4.2.6. UFC 3-600-01 Design: Fire Protection Engineering for Facilities. Use the latest edition of the IBC in coordination with this UFC. Use Chapters 3, 6, 7, 33 and UFC 3-600-01. If any conflict occurs between these Chapters and UFC 3-600-01, the requirements of UFC 3-600-01 take precedence. Use UFC 3-600-01 in lieu of IBC Chapters 4, 8,9,10.

4.2.7. UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings

4.2.8. UFC 4-023-03 Design of Buildings to Resist Progressive Collapse (Use most recent version, regardless of references thereto in other publications)

(a) Note the option to use tie force method or alternate path design for Occupancy Category II.

4.2.9. UFC 4-021-01 Design and O&M: Mass Notification Systems

4.2.10. Technical Criteria for Installation Information Infrastructure Architecture (I3A)

(a) Email: [DetrickISECI3Aguide@conus.army.mil](mailto:DetrickISECI3Aguide@conus.army.mil)

4.2.11. U.S. Army Information Systems Engineering Command (USAISEC) TG for the Integration of SECRET Internet Protocol (IP) Router Network (SIPRNET). See Paragraph 3 for applicability to specific facility type. May not apply to every facility. This is mandatory criteria for those facilities with SIPRNET.



## 5.0 GENERAL TECHNICAL REQUIREMENTS

This paragraph contains general technical requirements. See also Paragraph 3 for facility-specific technical requirements. Residential or similar grade finishes and materials are not acceptable for inclusion in these buildings, unless otherwise specifically allowed.

### 5.1. SITE PLANNING AND DESIGN

5.1.1. STANDARDS AND CODES: The site planning and design shall conform to APPLICABLE CRITERIA and to paragraph 6, PROJECT SPECIFIC REQUIREMENTS.

5.1.2. SITE PLANNING OBJECTIVES: Group buildings in configurations that create a sense of community and promote pedestrian use. See paragraph 3 for additional site planning requirements relating to building functions.

5.1.2.1. Provide enclosures and or visual screening devices for Outdoor Utility such as dumpsters, emergency generators, transformers, heating, ventilation, and air conditioning units from streetscape and courtyard views to limit visual impact. Enclosures shall be compatible with the building they serve and accessible by vehicle. The location of dumpsters can have a significant visual impact and should be addressed as part of an overall building design and incorporated in site planning.

5.1.2.2. Where included in the project, dumpster pads shall be concrete (minimum of 8 inches thick on 4 inch base course, unless site conditions dictate more conservative requirements) and directly accessible by way of a paved service drive or parking lot with adequate overhead clearance for collection vehicles. Provide space at dumpster areas for recycling receptacles. Coordinate with Installation on recycling receptacle types, sizes and access requirements and provide space at dumpster areas to accommodate them.

5.1.2.3. Vehicular Circulation. Apply design vehicle templates provided by the American Association of State Highway and Transportation Officials (AASHTO) to the site design. The passenger car class includes passenger cars and light trucks, such as vans and pick-ups. The passenger car template is equivalent to the non-organizational – privately owned vehicle (POV). The truck class template includes single-unit trucks, recreation vehicles, buses, truck tractor-semi-trailer combinations, and trucks or truck tractors with semi-trailers in combination with full trailers. Provide vehicle clearances required to meet traffic safety for emergency vehicles, service vehicles, and moving vans. Provide required traffic control signage Site entrances and site drive aisles shall maximize spacing between drives, incorporate right-angle turns, and limit points of conflict between traffic. Design Services Drives to restrict access to unauthorized vehicles by removable bollards, gates, or other barriers to meet Anti-Terrorism/Force Protection (ATFP) requirements. Orient service drives to building entrances other than the primary pedestrian entry at the front of the building.

5.1.2.4. Provide Emergency Vehicle Access around the facility and shall be in accordance with AT/FP requirements. Maintain a 33-foot clear zone buffer for emergency vehicles, designed to prevent other vehicles from entering the AT/FP standoff to the building.

5.1.2.5. Clear and grub all trees and vegetation necessary for construction; but, save as many trees as possible. Protect trees to be saved during the construction process from equipment.

5.1.2.6. Stormwater Management. Employ design and construction strategies (Best Management Practices) that reduce stormwater runoff, reduce discharges of polluted water offsite and maintain or restore predevelopment hydrology with respect to temperature, rate, volume and duration of flow to the maximum extent practicable. See paragraph 6, PROJECT SPECIFIC requirements for additional information.

5.1.3. EXTERIOR SIGNAGE: Provide exterior signage in accordance with Appendix H, Exterior Signage. Provide exterior NO SMOKING signage that conveys building and grounds smoking policy.

5.1.4. EXISTING UTILITIES: Base utilities maps and capacities for this site are included as part of this RFP. See paragraph 6 for more detailed information.

### 5.2. SITE ENGINEERING

5.2.1. STANDARDS AND CODES: The site engineering shall conform to APPLICABLE CRITERIA.

5.2.2. SOILS:

5.2.2.1. A report has been prepared to characterize the subsurface conditions at the project site and is **appended to these specifications**. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. The Contractor's team shall include a licensed geotechnical engineer to interpret the report and develop earthwork and foundation recommendations and design parameters in which to base the contractor's design. If any additional subsurface investigation or laboratory analysis is required to better characterize the site or develop the final design, the Contractor shall perform it under the direction of a licensed geotechnical engineer. There will be no separate payment for the cost of additional tests. If differences between the Contractor's additional subsurface investigation and the government provided soils report or the reasonably expected conditions require material revisions in the design, an equitable adjustment may be made, in accordance with the provisions of the Differing Site Conditions clause. The basis for the adjustment would be the design and construction appropriate for the conditions described in the Government furnished report or the reasonably expected conditions, in comparison with any changes required by material differences in the actual conditions encountered, in accordance with the terms of contract clause Differing Site Conditions.

5.2.2.2. The contractor's licensed geotechnical engineer shall prepare a final geotechnical evaluation report, to be submitted along with the first foundation design submittal, as described in Section 01 33 16, *Design After Award*.

5.2.3. VEHICLE PAVEMENTS: (as applicable to the project)

5.2.3.1. Design procedures and materials shall conform to one of the following: 1) the USACE Pavement Transportation Computer Assisted Structural Engineering (PCASE) program, 2) American Association of State Highway and Transportation Officials (AASHTO) or, 3) the applicable state Department of Transportation standards in which the project is located. See paragraph 5.2.2.2 and Section 01 33 16 for required information for the Contractor's geotechnical evaluation report. The minimum flexible pavement section shall consist of 2 inches of asphalt and 6 inches of base or as required by the pavement design, whichever is greater, unless specifically identified by the Government to be a gravel road. Design roads and parking areas for a life expectancy of 25 years with normal maintenance. Parking area for tactical vehicles (as applicable to the project) shall be Portland Cement Concrete (PCC) rigid pavement design. For concrete pavements, submit joint layout plan for review and concurrence. Design pavements for military tracked vehicles (as applicable to the project) IAW USACE PCASE. Traffic estimates for each roadway area will be as shown on the drawings or listed in Section 01 10 00 Paragraph 6.4.4. Pavement markings and traffic signage shall comply with the Installation requirements and with the Manual on Uniform Traffic Control Devices.

5.2.3.2. Parking Requirements.

- (a) All handicap POV parking lots (where applicable in the facility specific requirements) shall meet the ADA and ABA Accessibility Guidelines for accessible parking spaces.
- (b) Design POV parking spaces for the type of vehicles anticipated, but shall be a minimum of 9 ft by 18 ft for POVs, except for two wheel vehicles.

5.2.3.3. Sidewalks. Design the network of walks throughout the complex (where applicable) to facilitate pedestrian traffic among facilities, and minimize the need to use vehicles. Incorporate sidewalks to enhance the appearance of the site development, while creating a sense of entry at the primary patron entrances to the buildings. Minimum sidewalk requirements are in Paragraph 3, where applicable.

5.2.4. CATHODIC PROTECTION: Provide cathodic protection systems for all underground metallic systems and metallic fittings/portions of non-metallic, underground systems, both inside and outside the building 5 foot line that are subject to corrosion. Coordinate final solutions with the installation to insure an approach that is consistent with installation cathodic protection programs.

5.2.5. UTILITIES: See paragraph 6.4.6 for specific information on ownership of utilities and utility requirements. Meter all utilities (gas, water, and electric, as applicable) to each facility. For Government owned utilities, install meters that are wireless data transmission capable as well as have a continuous manual reading option. All meters will be capable of at least hourly data logging and transmission and provide consumption data for gas, water, and electricity. Gas and electric meters will also provide demand readings based on consumption over a maximum of

any 15 minute period. Configure all meters to transmit at least daily even if no receiver for the data is currently available at the time of project acceptance. For privatized utilities, coordinate with the privatization utility(ies) for the proper meter base and meter installation.

5.2.6. PERMITS: The CONTRACTOR shall be responsible for obtaining all permits (local, state and federal) required for design and construction of all site features and utilities.

5.2.7. IRRIGATION. Landscape irrigation systems, if provided, shall comply with the following:

5.2.7.1. Irrigation Potable Water Use Reduction. Reduce irrigation potable water use by 100 percent using LEED credit WE1.1 baseline (no potable water used for irrigation), except where precluded by other project requirements.

5.2.8. EPA WaterSense Products and Contractors. Except where precluded by other project requirements, use EPA WaterSense labeled products and irrigation contractors that are certified through a WaterSense labeled program where available.

### 5.3. ARCHITECTURE AND INTERIOR DESIGN:

This element will be evaluated per APPLICABLE CRITERIA under the quality focus.

5.3.1. STANDARDS AND CODES: The architecture and interior design shall conform to APPLICABLE CRITERIA.

5.3.2. GENERAL: Overall architectural goal is to provide a functional, quality, visually appealing facility that is a source of pride for the installation and delivered within the available budget and schedule.

5.3.3. COMPUTATION OF AREAS: See APPENDIX Q for how to compute gross and net areas of the facility(ies).

5.3.4. BUILDING EXTERIOR: Design buildings to enhance or compliment the visual environment of the Installation. Where appropriate, reflect a human scale to the facility. Building entrance should be architecturally defined and easily seen. When practical, exterior materials, roof forms, and detailing shall be compatible with the surrounding development and adjacent buildings on the Installation and follow locally established architectural themes. Use durable materials that are easy to maintain. Exterior colors shall conform to the Installation requirements. See paragraph 6.

5.3.4.1. Building Numbers: Each building shall have exterior signage permanently attached on two faces of the building indicating the assigned building number or address. Building number signage details and locations shall conform to Appendix H, Exterior Signage.

### 5.3.5. BUILDING INTERIOR

5.3.5.1. Space Configuration: Arrange spaces in an efficient and functional manner in accordance with area adjacency matrices.

5.3.5.2. Surfaces: Appearance retention is the top priority for building and furniture related finishes. Provide low maintenance, easily cleaned room finishes that are commercially standard for the facility occupancy specified, unless noted otherwise.

5.3.5.3. Color: The color, texture and pattern selections for the finishes of the building shall provide an aesthetically pleasing, comfortable, easily maintainable and functional environment for the occupants. Coordination of the building colors and finishes is necessary for a cohesive design. Color selections shall be appropriate for the building type. The use of color, texture and pattern shall be used to path or way find through the building. Trendy colors that will become dated shall be limited to non-permanent finishes such as carpet and paint. Finishes should be selected with regards to aesthetics, maintenance, durability, life safety and image. Limit the number of similar colors for each material. Color of Ceramic and porcelain tile grout shall be medium range color to help hide soiling. Plastic laminate and solid surface materials shall have patterns that are mottled, flecked or speckled. Finish colors of fire extinguisher cabinets, receptacle bodies and plates, fire alarms / warning lights, emergency lighting, and other miscellaneous items shall be coordinated with the building interior. Color of equipment items on ceilings (speakers, smoke detectors, grills, etc.) shall match the ceiling color.

5.3.5.4. Circulation: Circulation schemes must support easy way finding within the building.

5.3.5.5. Signage: Provide interior signage for overall way finding and life safety requirements. A comprehensive interior plan shall be from one manufacturer. Include the following sign types: (1) Lobby Directory, (2) Directional Signs; (3) Room Identification Signs; (4) Building Service Signs; (5) Regulatory Signs; (6) Official and Unofficial Signs (7) Visual Communication Boards (8) NO SMOKING signage that conveys building smoking policy. Use of emblems or logos may also be incorporated into the signage plan.

5.3.5.6. Window Treatment: Interior window treatments with adjustable control shall be provided in all exterior window locations for control of day light coming in windows or privacy at night. Uniformity of treatment color and material shall be maintained to the maximum extent possible within a building.

#### 5.3.6. COMPREHENSIVE INTERIOR DESIGN

5.3.6.1. Comprehensive Interior Design includes the integration of a Structural Interior Design (SID) and a Furniture, Fixtures and Equipment (FF&E) design and package. SID requires the design, selection and coordination of interior finish materials that are integral to or attached to the building structure. Completion of a SID involves the selection and specification of applied finishes for the building's interior features including, but not limited to, walls, floors, ceilings, trims, doors, windows, window treatments, built-in furnishings and installed equipment, lighting, and signage. The SID package includes finish schedules, finish samples and any supporting interior elevations, details or plans necessary to communicate the building finish design and build out. The SID also provides basic space planning for the anticipated FF&E requirements in conjunction with the functional layout of the building and design issues such as life safety, privacy, acoustics, lighting, ventilation, and accessibility. See Section 01 33 16 for SID design procedures.

The FF&E design and package includes the design, selection, color coordination and of the required furnishing items necessary to meet the functional, operational, sustainability, and aesthetic needs of the facility coordinated with the interior finish materials in the SID. The FF&E package includes the specification, procurement documentation, placement plans, ordering and finish information on all freestanding furnishings and accessories, and a cost estimate. Coordinate the selection of furniture style, function and configuration with the defined requirements. Examples of FF&E items include, but are not limited to workstations, seating, files, tables, beds, wardrobes, draperies and accessories as well as marker boards, tack boards, and presentation screens. Criteria for furniture selection include function and ergonomics, maintenance, durability, sustainability, comfort and cost. See Section 01 33 16 for FFE design procedures.

#### 5.4. STRUCTURAL DESIGN

5.4.1. STANDARDS AND CODES: The structural design shall conform to APPLICABLE CRITERIA.

5.4.2. GENERAL: The structural system needs to be compatible with the intended functions and components that allows for future flexibility and reconfigurations of the interior space. Select an economical structural system based upon facility size, projected load requirements and local availability of materials and labor. Base the structural design on accurate, site specific geotechnical information and anticipated loads for the building types and geographical location. Consider climate conditions, high humidity, industrial atmosphere, saltwater exposure, or other adverse conditions when selecting the type of cement and admixtures used in concrete, the concrete cover on reinforcing steel, the coatings on structural members, expansion joints, the level of corrosion protection, and the structural systems. Analyze, design and detail each building as a complete structural system. Design structural elements to preclude damage to finishes, partitions and other frangible, non-structural elements to prevent impaired operability of moveable components; and to prevent cladding leakage and roof ponding. Limit deflections of structural members to the allowable of the applicable material standard, e.g., ACI, AISC, Brick Industry Association, etc. When modular units or other pre-fabricated construction is used or combined with stick-built construction, fully coordinate and integrate the overall structural design between the two different or interfacing construction types. If the state that the project is located in requires separate, specific licensing for structural engineers (for instance, such as in Florida, California and others), then the structural engineer designer of record must be registered in that state.

5.4.3. LOADS: See paragraph 3 for facility specific (if applicable) and paragraph 6 for site and project specific structural loading criteria. Unless otherwise specified in paragraph 6, use Exposure Category C for wind. If not specified, use Category C unless the Designer of Record can satisfactorily justify another Exposure Category in its

design analysis based on the facility Master Plan. Submit such exceptions for approval as early as possible and prior to the Interim Design Submittal in Section "Design After Award". In addition to gravity, seismic and lateral loads, design the ancillary building items, e.g. doors, window jambs and connections, overhead architectural features, equipment bracing, for the requirements of UFC 4-010-01, DOD Minimum Antiterrorism Standards for Buildings. Ensure and document that the design of glazed items includes, but is not limited to, the following items under the design loads prescribed in UFC 4-010-01:

- (a) Supporting members of glazed elements, e.g. window jamb, sill, header
- (b) Connections of glazed element to supporting members, e.g. window to header
- (c) Connections of supporting members to each other, e.g. header to jamb
- (d) Connections of supporting members to structural system, e.g. jamb to foundation.

5.4.4. TERMITE TREATMENT: (Except Alaska) Provide termite prevention treatment in accordance with Installation and local building code requirements, using licensed chemicals and licensed applicator firm.

## 5.5. THERMAL PERFORMANCE

5.5.1. STANDARDS AND CODES: Building construction and thermal insulation for mechanical systems shall conform to APPLICABLE CRITERIA.

5.5.2. BUILDING ENVELOPE SEALING PERFORMANCE REQUIREMENT. Design and construct the building envelope for office buildings, office portions of mixed office and open space (e.g., company operations facilities), dining, barracks and instructional/training facilities with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components. Clearly identify the boundary limits of the building air barriers, and of the zone or zones to be tested for building air tightness on the drawings.

5.5.2.1. Trace a continuous plane of air-tightness throughout the building envelope and make flexible and seal all moving joints.

5.5.2.2. The air barrier material(s) must have an air permeance not to exceed 0.004 cfm / sf at 0.3" wg (0.02 L/s.m<sup>2</sup> @ 75 Pa) when tested in accordance with ASTM E 2178

5.5.2.3. Join and seal the air barrier material of each assembly in a flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of these assemblies and components.

5.5.2.4. Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement, or damage, and transfer the load to the structure.

5.5.2.5. Seal all penetrations of the air barrier. If any unavoidable penetrations of the air barrier by electrical boxes, plumbing fixture boxes, and other assemblies are not airtight, make them airtight by sealing the assembly and the interface between the assembly and the air barrier or by extending the air barrier over the assembly.

5.5.2.6. The air barrier must be durable to last the anticipated service life of the assembly.

5.5.2.7. Do not install lighting fixtures with ventilation holes through the air barrier

5.5.2.8. Provide a motorized damper in the closed position and connected to the fire alarm system to open on call and fail in the open position for any fixed open louvers such as at elevator shafts.

5.5.2.9. Damper and control to close all ventilation or make-up air intakes and exhausts, atrium smoke exhausts and intakes, etc when leakage can occur during inactive periods.

5.5.2.10. Compartmentalize garages under buildings by providing air-tight vestibules at building access points.

5.5.2.11. Compartmentalize spaces under negative pressure such as boiler rooms and provide make-up air for combustion.

5.5.2.12. Performance Criteria and Substantiation: Submit the qualifications and experience of the testing entity for approval. Demonstrate performance of the continuous air barrier for the opaque building envelope by the following tests:

(a) Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed 0.25cfm/ft<sup>2</sup> at a pressure differential of 0.3" w.g.(75 Pa) in accordance with ASTM's E 779 (2003) or E-1827-96 (2002). Accomplish tests using either pressurization or depressurization or both. Divide the volume of air leakage in cfm @ 0.3" w.g. (L/s @ 75 Pa) by the area of the pressure boundary of the building, including roof or ceiling, walls and floor to produce the air leakage rate in cfm/ft<sup>2</sup> @ 0.3" w.g. (L/s.m<sup>2</sup> @ 75 Pa). Do not test the building until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner.

(b) Test the completed building using Infrared Thermography testing. Use infrared cameras with a resolution of 0.1deg C or better. Perform testing on the building envelope in accordance with ISO 6781:1983 and ASTM C1060-90(1997). Determine air leakage pathways using ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems, and perform corrective work as necessary to achieve the whole building air leakage rate specified in (a) above.

(c) Notify the Government at least three working days prior to the tests to provide the Government the opportunity to witness the tests. Provide the Government written test results confirming the results of all tests.

## 5.6. PLUMBING

5.6.1. STANDARDS AND CODES: The plumbing system shall conform to APPLICABLE CRITERIA.

5.6.2. PRECAUTIONS FOR EXPANSIVE SOILS: Where expansive soils are present, the design for underslab piping systems and underground piping serving chillers, cooling towers, etc, shall include features to control forces resulting from soil heave. Some possible solutions include, but are not necessarily limited to, features such as flexible expansion joints, slip joints, horizontal offsets with ball joints, or multiple bell and spigot gasketed fittings. For structurally supported slabs, piping should be suspended from the structure with adequate space provided below the pipe for the anticipated soil movement.

5.6.3. HOT WATER SYSTEMS: For Hot Water heating and supply, provide a minimum temp of 140 Deg F in the storage tank and a maximum of 110 Deg F at the fixture, unless specific appliances or equipment specifically require higher temperature water supply.

5.6.4. SIZING HOT WATER SYSTEMS: Unless otherwise specified or directed in paragraph 3, design in accordance with ASHRAE Handbook Series (appropriate Chapters), ASHRAE Standard 90.1, and the energy conservation requirements of the contract. Size and place equipment so that it is easily accessible and removable for repair or replacement.

5.6.5. JANITOR CLOSETS: In janitor spaces/room/closets, provide at minimum, a service sink with heavy duty shelf and wall hung mop and broom rack(s).

5.6.6. FLOOR DRAINS: As a minimum, provide floor drains in mechanical rooms and areas, janitor spaces/rooms/closets and any other area that requires drainage from fixtures or equipment, drain downs, condensate, as necessary.

5.6.7. URINALS: Urinals shall be vitreous china, wall-mounted, wall outlet, non-water using, with integral drain line connection, and with sealed replaceable cartridge or integral liquid seal trap. Either type shall use a biodegradable liquid to provide the seal and maintain a sanitary and odor-free environment. Install, test and maintain in accordance with manufacturer's recommendations. Slope the sanitary sewer branch line for non-water use urinals a minimum of 1/4 inch per foot. Do not use copper tube or pipe for drain lines that connect to the urinal. Manufacturer shall provide an operating manual and on-site training to installation operations personnel for the proper care and maintenance of the urinal. For complexes, non-water using urinals are not required for barracks type spaces.

5.6.8. BUILDING WATER USE REDUCTION. Reduce building potable water use in each building 30 percent using IPC fixture performance requirements baseline.

5.6.9. Do not use engineered vent or Sovent® type drainage systems.

5.6.10. Where the seasonal design temperature of the cold water entering a building is below the seasonal design dew point of the indoor ambient air, and where condensate drip will cause damage or create a hazard, insulate plumbing piping with a vapor barrier type of insulation to prevent condensation. Do not locate water or drainage piping over electrical wiring or equipment unless adequate protection against water (including condensation) damage is provided. Insulation alone is not adequate protection against condensation. Follow ASHRAE Fundamentals Chapter 23, Insulation for Mechanical Systems, IMC paragraph 1107 and International Energy Conservation Code for pipe insulation requirements.

## 5.7. ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

5.7.1. STANDARDS AND CODES: The electrical systems for all facilities shall conform to APPLICABLE CRITERIA.

5.7.2. MATERIALS AND EQUIPMENT: Materials, equipment and devices shall, as a minimum, meet the requirements of Underwriters Laboratories (UL) where UL standards are established for those items. Wiring for branch circuits shall be copper. Motors larger than one-half horsepower shall be three phase. All electrical systems shall be pre-wired and fully operational unless otherwise indicated. Wall mounted electrical devices (power receptacles, communication outlets and CATV outlets) shall have matching colors, mounting heights and faceplates.

5.7.3. POWER SERVICE: Primary service from the base electrical distribution system to the pad-mounted transformer and secondary service from the transformer to the building service electrical equipment room shall be underground. See paragraph 6 for additional site electrical requirements.

5.7.3.1. Spare Capacity: Provide 10% space for future circuit breakers in all panelboards serving residential areas of buildings and 15% spaces in all other panelboards.

5.7.4. TELECOMMUNICATION SERVICE: The project's facilities must connect to the Installation telecommunications (voice and data) system through the outside plant (OSP) telecommunications underground infrastructure cabling system per the I3A Criteria. Connect to the OSP cabling system from each facility main cross connect located in the telecommunications room.

5.7.5. LIGHTING: Comply with the recommendations of the Illumination Engineering Society of North America (IESNA), the National Energy Policy Act and Energy Star requirements for lighting products..

### 5.7.5.1. Interior Lighting:

(a) Reflective Surfaces: Coordinate interior architectural space surfaces and colors with the lighting systems to provide the most energy-efficient workable combinations.

(b) High Efficiency Fluorescent Lighting: Utilize NEMA premium electronic ballasts and energy efficient fluorescent lamps with a Correlated Color Temperature (CCT) of 4100K. Linear fluorescent and compact fluorescent fixtures shall have a Color Rendering Index of (CRI) of 87 or higher. Fluorescent lamps shall be the low mercury type qualifying as non-hazardous waste upon disposal. Do not use surface mounted fixtures on acoustical tile ceilings. Provide an un-switched fixture with emergency ballast shall be provided at each entrance to the building.

(c) Solid State Lighting: Fixtures shall provide lighting with a minimum Correlated Color Temperature (CCT) of 4100K and shall have a Color Rendering Index of (CRI) of 75 or higher. Verify performance of the light producing solid state components by a test report in compliance with the requirements of IESNA LM 80. Verify performance of the solid state light fixtures by a test report in compliance with the requirements of IESNA LM 79. Provide lab results by a NVLAP certified laboratory. The light producing solid state components and drivers shall have a life expectancy of 50,000 operating hours while maintaining at least 70% of original illumination level. Provide a complete five year warranty for fixtures.

- (d) Metal Halide Lighting (where applicable): Metal Halide lamp fixtures in the range of 150-500 Watts shall be pulse start type and have a minimum efficiency rating of 88%.
- (e) Lighting Controls: ANSI/ASHRAE/IESNA 90.1 has specific lighting controls requirements. Provide a high level of lighting system control by individual occupants or by specific groups in multi-occupant spaces (classrooms, conference rooms) to promote the productivity, comfort and well being of the building occupants. In office spaces, the preferred lighting should be a 30 FC ambient lighting level with occupancy sensor controlled task lighting in the work spaces to provide a composite lighting level of 50 FC on the working surfaces. Consider incorporating daylighting techniques for the benefit of reducing lighting energy requirements while improving the quality of the indoor spaces. If daylight strategies are used, additional coordination is required with the architect and mechanical engineer. Additionally, incorporate electric lighting controls to take advantage of the potential energy savings.
- (f) Exterior Lighting: See paragraph 6.9 for site specific information, if any, on exterior lighting systems. Minimize light pollution and light trespass by not over lighting and use cutoff type exterior luminaires.

5.7.6. TELECOMMUNICATION SYSTEM: All building telecommunications cabling systems (BCS) and OSP telecommunications cabling system shall conform to APPLICABLE CRITERIA to include I3A Technical Criteria. An acceptable BCS encompasses, but is not limited to, copper and fiber optic (FO) entrance cable, termination equipment, copper and fiber backbone cable, copper and fiber horizontal distribution cable, workstation outlets, racks, cable management, patch panels, cable tray, cable ladder, conduits, grounding, and labeling.. Items included under OSP infrastructure encompass, but are not limited to, manhole and duct infrastructure, copper cable, fiber optic cable, cross connects, terminations, cable vaults, and copper and FO entrance cable.

5.7.6.1. Design, install, label and test all telecommunications systems in accordance with the I3A Criteria and ANSI/TIA/EIA 568, 569, and 606 standards. A Building Industry Consulting Services International (BICSI) Registered Communications Distribution Designer (RCDD) with at least 2 yrs related experience shall develop and stamp telecommunications design, and prepare the test plan. See paragraph 5.8.2.5 for design of environmental systems for Telecommunications Rooms.

5.7.6.2. The installers assigned to the installation of the telecommunications system or any of its components shall be regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. Key personnel; i.e., supervisors and lead installers assigned to the installation of this system or any of its components shall be BICSI Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel. In lieu of BICSI certification, supervisors and installers shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

5.7.6.3. Perform a comprehensive end to end test of all circuits to include all copper and fiber optic cables upon completion of the BCS and prior to acceptance of the facility. The BCS circuits include but are not limited to all copper and fiber optic(FO) entrance cables, termination equipment, copper and fiber backbone cable, copper and fiber horizontal distribution cable, and workstation outlets. Test in accordance with ANSI/EIA/TIA 568 standards. Use test instrumentation that meets or exceeds the standard. Submit the official test report to include test procedures, parameters tested, values, discrepancies and corrective actions in electronic format. Test and accomplish all necessary corrective actions to ensure that the government receives a fully operational, standards based, code compliant telecommunications system.

5.7.7. LIGHTNING PROTECTION SYSTEM: Provide a lightning protection system where recommended by the Lightning Risk Assessment of NFPA 780, Annex L.

## 5.8. HEATING, VENTILATING, AND AIR CONDITIONING

5.8.1. STANDARDS AND CODES: The HVAC system shall conform to APPLICABLE CRITERIA.

5.8.2. DESIGN CONDITIONS.

5.8.2.1. Outdoor and indoor design conditions shall be in accordance with UFC 3-410-01FA. Outdoor air and exhaust ventilation requirements for indoor air quality shall be in accordance with ASHRAE 62.1. All Buildings with minimum LEED Silver requirement (or better) will earn LEED Credit EQ 7.1, Thermal Comfort-Design.



5.8.2.2. Design systems in geographical areas that meet the definition for high humidity in UFC 3-410-01FA in accordance with the special criteria for humid areas therein.

5.8.2.3. Cooling equipment may be oversized by up to 15 percent to account for recovery from night setback. Heating equipment may be oversized by up to 30 percent to account for recovery from night setback. Design single zone systems and multi-zone systems to maintain an indoor design condition of 50% relative humidity for cooling only. For heating only where the indoor relative humidity is expected to fall below 20% for extended periods, add humidification to increase the indoor relative humidity to 30%. Provide ventilation air from a separate dedicated air handling unit (DOAU) for facilities using multiple single zone fan-coil type HVAC systems. Do not condition outside air through fan coil units. Avoid the use of direct expansion cooling coils in air handling units with constant running fans that handle outside air.

5.8.2.4. Locate all equipment so that service, adjustment and replacement of controls or internal components are readily accessible for easy maintenance.

5.8.2.5. Environmental Requirements for Telecommunications Rooms,(including SIPRNET ROOMS, where applicable for specific facility type). Comply with ANSI/EIA/TIA 569 and the I3A.

5.8.2.6. Fire dampers: dynamic type with a dynamic rating suitable for the maximum air velocity and pressure differential to which the damper is subjected. Test each fire damper with the air handling and distribution system running.

5.8.3. BUILDING AUTOMATION SYSTEM. The Building Automation System (BAS) shall be a single complete non-proprietary Direct Digital Control (DDC) system for control of the heating, ventilating and air conditioning (HVAC) and other building systems. The BAS shall be based on an Open implementation of BACnet using ASHRAE 135-2004 exclusively as the communications protocol for communication between DDC Hardware devices to allow multi-vendor interoperability. The building BAS shall include integration to a basewide supervisory monitoring and control (M&C) system.

5.8.3.1. The system shall be Open in that it is designed and installed such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without further dependence on the original hardware vendor or their agents. This includes, but is not limited to the following:

- Hardware shall be installed such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.
- Necessary documentation (including rights to documentation and data), configuration information, configuration tools, application programs (with comments explaining program logic), application source code for programmable controllers, drivers, and other software shall be licensed to and remain with the Government such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor.

5.8.3.2. All DDC Hardware shall:

- Be connected to a ASHRAE 135 MS/TP control network.
- Implement all required functionality of the application network interface via BACnet objects, properties, and services
- Shall conform to basewide addressing schemes, particularly with regard to Device ID.
- Minimize the use of proprietary BACnet objects and properties
- Not use any of the following BACnet services for application control functionality or communication:
  - AtomicFile or AtomicFileWrite
  - ConfirmedTextMessage or UnconfirmedTextMessage
  - ConfirmedPrivateTransfer or UnconfirmedPrivateTransfer
- Communicate over the control network via ASHRAE 135 exclusively.
- Conform to the BACnet Testing Lab's Device Implementation Guidelines.
- Be capable of responding to Who-Is/I-Am and Who-Has/I-Have service requests.
- All settings and parameters used by the application shall be fully configurable:
  - to the greatest extent possible, via properties of BACnet objects that can be written to via BACnet services.
  - via properties of BACnet objects that can be written to via BACnet services for the following

- Setpoint
- Alarm limit
- Schedule modification
- Trend modification
  - All other settings and parameters that can not be written to via BACnet services shall be fully configurable via either:
- Properties of BACnet objects that can be written to with a configuration tool, or
- Hardware settings on the controller itself to support the application.
- Provide BACnet objects, properties, and services required to support the application and supervisory monitoring and control functionality including:
  - System start/stop and overrides.
  - Scheduling
  - Alarming
  - Trending
- To the greatest extent practical, not rely on the control network to perform the application
- Be BTL Listed

5.8.3.3. Include any device capable of communicating over IEEE 802.3 (Ethernet) in a DIACAP and Certificate of Networkiness (CoN) for this installation, regardless of whether the Ethernet connection is active at time of installation. Do not use devices with Ethernet connection capability not included in a DIACAP or without a DIACAP or without a CoN shall not be used.

5.8.3.4. Gateways may be used provided that each gateway communicates with and performs protocol translation for control hardware controlling one and only one package unit.

5.8.3.5. Perform all necessary actions needed to fully integrate the ASHRAE 135-based building control system to the UMCS. These actions include but are not limited to:

- Install BACnet MS/TP-to-IP routers and/or BACnet/IP Broadcast Management Devices (BBMD) in accordance with ASHRAE 135 Annex J as needed to connect the building control network to the UMCS IP network. Devices shall be capable of configuration via DHCP and Write-Broadcast-Distribution-Table messages but shall not rely on these services for configuration. All communication between the UMCS and building networks shall be via BACnet/IP and in accordance with ASHRAE 135. Any IP network work including access to existing networks shall be coordinated with the installation Network Enterprise Center (NEC).
- Configure M&C Software functionality including: graphical pages for System Graphic Displays including overrides, alarm handling, scheduling, trends for critical values needing long-term or permanent monitoring via trends, and demand limiting.
- Configure M&C software to provide hierarchically arranged screens to allow operator to configure (via BACnet services to the appropriate objects) all devices on the installation BACnet internetwork. The following adjustments shall be supported:
  - Setpoints
  - Alarm limits
  - Schedules
  - Trends

This requirement is separate from and in addition to the requirement to provide all necessary programming and configuration software.

5.8.3.6. Perform all necessary actions needed to integrate legacy systems to the UMCS. Configure M&C Software functionality including: graphical pages for System Graphic Displays including overrides, alarm handling, scheduling, trends for critical values needing long-term or permanent monitoring via trends, and demand limiting. Integration may be via drivers in the M&C Software or hardware gateways may be provided. Where hardware gateways are provided, include all hardware, software, software licenses, and configuration tools required for gateway operation, modification, and maintenance. Configure software driver or a hardware gateway to support M&C software functionality as listed above.

5.8.3.7. Provide the following to the Government for review prior to acceptance of the system:

- The latest version of all software including source code for application software (for programmable

controllers), software licenses, and user manuals required to program, configure and operate the system.

- Points Schedule drawing that shows every DDC Hardware device. The Points Schedule shall contain the following information as a minimum for each device:
  - Device ID and network address (MS/TP network and MAC address, or IP address).
  - Input and Output Objects including Name, Type, Description, and relevant supported or required Properties.
  - Hardware I/O, including Type (AI, AO, BI, BO) and Description.
  - Alarm information including alarm limits and BACnet device IDs, object IDs, and property information.
  - Supervisory control information including BACnet device IDs, object IDs, and properties for trending and overrides.
  - Objects and Properties needed for device configuration.
  - Device IDs and objects (where applicable) of remote devices and objects that communicate with the given Device (e.g. clients and servers for BACnet services used by the given device).
  - Example Points Schedules are available at: <https://eko.usace.army.mil/fa/besc/>
- Riser diagram of the network showing all network cabling and hardware. Label hardware with BACnet Device IDs, BACnet network addresses, network names, and locations.
- A consolidated list of all Device IDs.
- Control System Schematic diagram and Sequence of Operation for each controlled system.
- Operation and Maintenance Instructions including procedures for system start-up, operation and shut-down, a routine maintenance checklist, and a qualified service organization list.
- Quality Control (QC) checklist (below) completed by the Contractor's Chief Quality Control (QC) Representative

**Table 5-1: QC Checklist**

Instructions: Initial each item, sign and date verifying that the requirements have been met.		
#	Description	Initials
1	All DDC Hardware is installed on a MS/TP or IP local control bus IAW ASHRAE135 section 9 or Annex J.	
2	Communication between DDC Hardware is only via ASHRAE 135. PrivateTransfer, TextMessage, or AtomicFile services have not been used.	
3	All sequences are performed using DDC Hardware.	
4	All software has been licensed to the Government	
5	Final As-built Drawings accurately represent the final installed system.	
6	O&M Instructions have been completed and submitted.	
7	All DDC hardware connected or intended to be connected to the IP network is covered under a DIACAP and has a certificate of Networkiness	
8	M&C software monitoring displays have been created for all building systems, including all override and display points indicated on Points Schedule drawings	
9	Connections between the UMCS IP network and ASHRAE 135 building networks is in accordance with ASHRAE 135 Annex J, including BACnet Broadcast Management Devices (BBMDs) as needed.	
By signing below I verify that all requirements of the contract, including but not limited to the above, been met.		
Signature: _____ Date: _____		

5.8.3.8. Perform a Performance Verification Test (PVT) under Government supervision prior to system acceptance. During the PVT, demonstrate that the system performs as specified, including but not limited to demonstrating that the system is Open and correctly performs the Sequences of Operation.

5.8.3.9. Provide a 1 year unconditional warranty on the installed system and on all service call work. The warranty shall include labor and material necessary to restore the equipment involved in the initial service call to a fully operable condition.

5.8.3.10. Provide training at the project site on the installed building system . Upon completion of this training each student, using appropriate documentation, should be able to start the system, operate the system, recover the system after a failure, perform routine maintenance and describe the specific hardware, architecture and operation of the system.

5.8.4. TESTING, ADJUSTING AND BALANCING. Test and balance air and hydronic systems, using a firm certified for testing and balancing by the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or the Testing Adjusting, and Balancing Bureau (TABB). The prime contractor shall hire the TAB firm directly, not through a subcontractor. Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB TABES, or SMACNA HVACTAB unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practicable to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, the TAB Specialist shall develop TAB procedures. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are mandatory.

5.8.5. COMMISSIONING: Commission all HVAC systems and equipment, including controls, and all systems requiring commissioning for LEED Enhanced commissioning, in accordance with ASHRAE Guideline 1.1, ASHRAE Guideline 0 and LEED. Do not use the sampling techniques discussed in ASHRAE Guideline 1.1 and in ASHRAE Guideline 0. Commission 100% of the HVAC controls and equipment. Hire the Commissioning Authority (CA), certified as a CA by AABC, NEBB, or TABB, as described in Guideline 1.1. The CA will be an independent subcontractor and not an employee of the Contractor nor an employee or subcontractor of any other subcontractor on this project, including the design professionals (i.e., the DOR or their firm(s)). The CA will communicate and report directly to the Government in execution of commissioning activities. The Contracting Officer's Representative will act as the Owner's representative in performance of duties spelled out under OWNER in Annex F of ASHRAE Guideline 0. All buildings with Minimum LEED Silver (or better) requirement will earn LEED Credit EA3 Enhanced Commissioning.

## 5.9. ENERGY CONSERVATION

5.9.1. The building including the building envelope, HVAC systems, service water heating, power, and lighting systems shall meet the Mandatory Provisions and the Prescriptive Path requirements of ASHRAE 90.1. Substantiation requirements are defined in Section 01 33 16, Design After Award.

5.9.2. Design all building systems and elements to meet the minimum requirements of ANSI/ASHRAE/IESNA 90.1. Design the buildings, including the building envelope, HVAC systems, service water heating, power, and lighting systems to achieve an energy consumption that is at least 40% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1. Energy calculation methodologies and substantiation requirements are defined in Section 01 33 16, Design After Award.

5.9.3. Purchase Energy Star products, except use FEMP designated products where FEMP is applicable to the type product. The term "Energy Star product" means a product that is rated for energy efficiency under an Energy Star program. The term "FEMP designated product" means a product that is designated under the Federal Energy Management Program of the Department of Energy as being among the highest 25 percent of equivalent products for energy efficiency. When selecting integral sized electric motors, choose NEMA PREMIUM type motors that conform to NEMA MG 1, minimum Class F insulation system. Motors with efficiencies lower than the NEMA PREMIUM standard may only be used in unique applications that require a high constant torque speed ratio (e.g., inverter duty or vector duty type motors that conform to NEMA MG 1, Part 30 or Part 31).

5.9.4. Solar Hot Water Heating. Provide at least 30% of the domestic hot water requirements through solar heating methodologies, unless the results of a Life Cycle Cost Analysis (LCCA) developed utilizing the Building Life Cycle Cost Program (BLCC) which demonstrates that the solar hot water system is not life cycle cost effective in comparison with other hot water heating systems. The type of system will be established during the contract or task order competition and award phase, including submission of an LCCA for government evaluation to justify non-selection of solar hot water heating. The LCCA uses a study period of 25 years and the Appendix K utility cost information. The LCCA shall include life cycle cost comparisons to a baseline system to provide domestic hot water without solar components, analyzing at least three different methodologies for providing solar hot water to compare against the baseline system.

5.9.5. Process Water Conservation. When potable water is used to improve a building's energy efficiency, employ lifecycle cost effective water conservation measures, except where precluded by other project requirements.

5.9.6. Renewable Energy Features. The Government's goal is to implement on-site renewable energy generation for Government use when lifecycle cost effective. See Paragraph 6, PROJECT SPECIFIC REQUIREMENTS for renewable energy requirements for this project.

## 5.10. FIRE PROTECTION

5.10.1. STANDARDS AND CODES Provide the fire protection system conforming to APPLICABLE CRITERIA.

5.10.2. Inspect and test all fire suppression equipment and systems, fire pumps, fire alarm and detection systems and mass notification systems in accordance with the applicable NFPA standards. The fire protection engineer of record shall witness final tests. The fire protection engineer of record shall certify that the equipment and systems are fully operational and meet the contract requirements. Two weeks prior to each final test, the contractor shall notify, in writing, the installation fire department and the installation public work representative of the test and invite them to witness the test.

5.10.3. Fire Extinguisher Cabinets: Provide fire extinguisher cabinets and locations for hanging portable fire extinguishers in accordance with NFPA 10 Standard for Portable Fire Extinguishers.

5.10.4. Fire alarm and detection system: Required fire alarm and detection systems shall be the addressable type. Fire alarm initiating devices, such as smoke detectors, heat detectors and manual pull stations shall be addressable. When the system is in alarm condition, the system shall annunciate the type and location of each alarm initiating device. Sprinkler water flow alarms shall be zoned by building and by floor. Supervisory alarm initiating devices, such as valve supervisory switches, fire pump running alarm, low-air pressure on dry sprinkler system, etc. shall be zoned by type and by room location.

5.10.5. Fire Protection Engineer Qualifications: In accordance with UFC 3-600-01, FIRE PROTECTION ENGINEERING FOR FACILITIES, the fire protection engineer of record shall be a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES), or a registered P.E. in a related engineering discipline with a minimum of 5 years experience, dedicated to fire protection engineering that can be verified with documentation.

## 5.11. SUSTAINABLE DESIGN

5.11.1. STANDARDS AND CODES: Sustainable design shall conform to APPLICABLE CRITERIA. See paragraph 6, PROJECT-SPECIFIC REQUIREMENTS for which version of LEED applies to this project. The LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects (AGMBC) applies to all projects. Averaging may be used for LEED compliance as permitted by the AGMBC but is restricted to only those buildings included in this project. Each building must individually comply with the requirements of paragraphs ENERGY CONSERVATION and BUILDING WATER USE REDUCTION.

5.11.2. LEED RATING, REGISTRATION, VALIDATION AND CERTIFICATION: See Paragraph PROJECT-SPECIFIC REQUIREMENTS for project minimum LEED rating/achievement level, for facilities that are exempt from the minimum LEED rating, for LEED registration and LEED certification requirements and for other project-specific information and requirements.

5.11.2.1. Innovation and Design Credits. LEED Innovation and Design (ID) credits are acceptable only if they are supported by formal written approval by GBCI (either published in USGBC Innovation and Design Credit Catalog or accompanied by a formal ruling from GBCI). LEED ID credits that require any Owner actions or commitments are acceptable only when Owner commitment is indicated in paragraph PROJECT-SPECIFIC REQUIREMENTS or Appendix LEED Project Credit Guidance

5.11.3. OPTIMIZE ENERGY PERFORMANCE. : Project must earn, as a minimum, the points associated with compliance with paragraph ENERGY CONSERVATION. LEED documentation differs from documentation requirements for paragraph ENERGY CONSERVATION and both must be provided. For LEED-NC v2.2 projects you may substitute ASHRAE 90.1 2007 Appendix G in its entirety for ASHRAE 90.1 2004 in accordance with USGBC Credit Interpretation Ruling dated 4/23/2008.

5.11.4. COMMISSIONING. See paragraph 5.8.5 COMMISSIONING for commissioning requirements. USACE templates for the required Basis of Design document and Commissioning Plan documents are available at <http://en.sas.usace.army.mil> (click on Engineering Criteria) and may be used at Contractor's option.

5.11.5. DAYLIGHTING. Except where precluded by other project requirements, do the following in at least 75 percent of all spaces occupied for critical visual tasks: achieve a 2 percent glazing factor (calculated in accordance with LEED credit EQ8.1) OR earn LEED Daylighting credit, provide appropriate glare control and provide either automatic dimming controls or occupant-accessible manual lighting controls.

5.11.6. LOW-EMITTING MATERIALS. Except where precluded by other project requirements, use materials with low pollutant emissions, including but not limited to composite wood products, adhesives, sealants, interior paints and finishes, carpet systems and furnishings,

5.11.7. CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT. Except where precluded by other project requirements, earn LEED credit EQ 3.1 Construction IAQ Management Plan, During Construction and credit EQ 3.2 Construction IAQ Management Plan, Before Occupancy.

5.11.8. RECYCLED CONTENT. In addition to complying with section RECYCLED/RECOVERED MATERIALS, earn LEED credit MR4.1, Recycled Content, 10 percent except where precluded by other project requirements.

5.11.9. BIOBASED AND ENVIRONMENTALLY PREFERABLE PRODUCTS. Except where precluded by other project requirements, use materials with biobased content, materials with rapidly renewable content, FSC certified wood products and products that have a lesser or reduced effect on human health and the environment over their lifecycle to the maximum extent practicable.

5.11.10. FEDERAL BIOBASED PRODUCTS PREFERRED PROCUREMENT PROGRAM (FB4P). The Farm Security and Rural Investment Act (FSRIA) of 2002 required the U.S. Department of Agriculture (USDA) to create procurement preferences for biobased products that are applicable to all federal procurement (to designate products for biobased content). For all designated products that are used in this project, meet USDA biobased content rules for them except use of a designated product with USDA biobased content is not required if the biobased product (a) is not available within a reasonable time, (b) fails to meet performance standard or (c) is available only at an unreasonable price. For biobased content product designations, see <http://www.biopreferred.gov/ProposedAndFinalItemDesignations.aspx>.

5.12. CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT: Achievement of 50% diversion, by weight, of all non-hazardous C&D waste debris is required. Reuse of excess soils, recycling of vegetation, alternative daily cover, and wood to energy are not considered diversion in this context, however the Contractor must track and report it. A waste management plan and waste diversion reports are required, as detailed in Section 01 57 20.00 10, ENVIRONMENTAL PROTECTION.

5.13. SECURITY (ANTI-TERRORISM STANDARDS): Unless otherwise specified in Project Specific Requirements, only the minimum protective measures as specified by the current Department of Defense Minimum Antiterrorism Standards for Buildings, UFC 4-010-01, are required for this project. The element of those standards that has the most significant impact on project planning is providing protection against explosives effects. That protection can either be achieved using conventional construction (including specific window requirements) in conjunction with establishing relatively large standoff distances to parking, roadways, and installation perimeters or through building hardening, which will allow lesser standoff distances. Even with the latter, the minimum standoff

distances cannot be encroached upon. These setbacks will establish the maximum buildable area. All standards in Appendix B of UFC 4-010-01 must be followed and as many of the recommendations in Appendix C that can reasonably be accommodated should be included. The facility requirements listed in these specifications assume that the minimum standoff distances can be met, permitting conventional construction. Lesser standoff distances (with specific minimums) are not desired, however can be provided, but will require structural hardening for the building. See Project Specific Requirements for project specific siting constraints. The following list highlights the major points but the detailed requirements as presented in Appendix B of UFC 4-010-01 must be followed.

- (a) Standoff distance from roads, parking and installation perimeter; and/or structural blast mitigation
- (b) Blast resistant windows and skylights, including glazing, frames, anchors, and supports
- (c) Progressive collapse resistance for all facilities 3 stories or higher
- (d) Mass notification system (shall also conform to UFC 4-021-01, Mass Notification Systems)
- (e) For facilities with mailrooms (see paragraph 3 for applicability) – mailrooms have separate HVAC systems and are sealed from rest of building

## **6.0 PROJECT SPECIFIC REQUIREMENTS**

### **6.1. GENERAL**

The requirements of this paragraph augment the requirements indicated in Paragraphs 3 through 5.

### **6.2. APPROVED DEVIATIONS**

The following are approved deviations from the requirements stated in Paragraphs 3 through 5 that only apply to this project.

#### **6.2.1 ADDITIONAL AND UPDATED CRITERIA - (This criteria takes precedence over previous criteria, Paragraph 4 of this Section)**

##### CIVIL

UFC 3-260-01 Airfield and Heliport Planning and Design

UFC 3-260-02 Pavement Design for Airfields

##### ARCHITECTURAL

UFC 4-211-01 Aircraft Maintenance Hangars: Type I, Type II and Type III

UFC 4-211-02 Corrosion Control and Paint Finishing Hangars

ADAAGADA Accessibility Guidelines for Buildings and Facilities

##### COMMUNICATIONS

TIA-568-C.0 (2009) Generic Telecommunications Cabling for Customer Premises

TIA-568-C.1 (2009) Commercial Building Telecommunications Cabling Standard

TIA-568-C.2 (2009) Balanced Twisted Pair Telecommunications Cabling and Components Standard

TIA-568-C.3 (Aug 2008) Optical Fiber Cabling Components Standard

BICSI TDMM (Latest edition) Building Industry Consulting Services International - Telecommunications Distribution Methods Manual



BICSI OSPDRM (Latest edition) Building Industry Consulting Services International - Outside Plant Design Reference Manual

BICSI ITSIM (Latest edition) Building Industry Consulting Services International - Information Transport Systems Installation Manual

IEEE C2 (2008) National Electrical Safety Code

AF ETL 02-12 (June 2002) Communications and Information Systems Criteria for Air Force Facilities

I3A (Feb 2010) Technical Criteria for the Installation Information Infrastructure Architecture

FED-STD 795 (Basic; Am 1) Uniform Federal Accessibility Standards (UFAS)

LAFBTBCSS Langley AFB Telecommunications Building Cabling Systems Standards. Appendix EE.

LAFBTOSPCSS Langley Air Force Base Telecommunication OSP Cabling System Standards. Appendix FF.

### FIRE PROTECTION

AF ETL 02 15 Air Force Engineering Technical Letter (AF ETL) 02-15: Fire Protection Engineering Criteria - New Aircraft facilities

NFPA 11 Standard for Low-, Medium-, and High-Expansion Foam

NFPA 33 Spray Applications Using Flammable or Combustible Materials

NFPA 409 Standard on Aircraft Hangars

NFPA 1141 Standard for Fire Protection in Planned Building Groups

#### **6.2.2 DEVIATIONS - (These specifications take precedence over previous specifications, Paragraphs 4 and 5 of this Section)**

### GENERAL

Paragraph 4.2.2 Executive Order 12770: Metric Usage In Federal Government. This Executive Order is not economically feasible in this project..

Paragraph 4.2.10 Technical. Criteria for Installation Information Infrastructure Architecture (I3A): Contrary to the criteria referenced in 4.2.10 above, all Communications, Installation Information Infrastructure Architecture shall be based on Appendices EE and FF.

Paragraph 4.2.11 U.S. Army Information Systems Engineering Command (USAISEC): Contrary to the criteria referenced in 4.2.11 above, all Communications, Installation Information Infrastructure Architecture shall be based on Appendices EE and FF.

### CIVIL

Paragraph 5.2.3.1 Roadways: Gravel roads, with the exception of a Construction Exit used for Erosion and Sediment Control purposes where the minimum stone size is 3" or larger are NOT permitted due to the proximity of aircraft.

### COMMUNICATIONS

Paragraph 5.7.4 Telecommunication Service: Reference to the I3A Criteria does not apply to this Request for Proposal. Replace with 633rd Communication Squadron (CS/SCXP) Criteria. See Appendix EE.

Paragraph 5.7.6 Telecommunication System: Reference to the I3A Technical Criteria does not apply to this Request for Proposal. Replace with 633rd Communication Squadron (CS/SCXP) Criteria. See Appendix EE.

Paragraph 5.7.6.1 Telecommunication System: Reference to the I3A Criteria does not apply to this Request for Proposal. Replace with 633rd Communication Squadron (CS/SCXP) Criteria. See Appendix EE.

Paragraph 5.8.2.5 Telecommunication System: Reference to the I3A does not apply to this Request for Proposal. Replace with 633rd Communication Squadron (CS/SCXP) Criteria. See Appendix EE

Paragraph 5.8.3.5 Telecommunication System: Reference to the Network Enterprise Center (NEC) does not apply to this Request for Proposal. Replace with 633rd Communication Squadron (CS/SCXP) Criteria. See Appendix EE

### ARCHITECTURAL

Paragraph 5.3.4 Building Exterior: Add "Building exterior finishes shall match the existing exterior and fall within the contract cost limitation."

Paragraph 5.3.4.1 Building Numbers: Building numbers and address signs will be provided and installed by the Government and NOT by the Contractor.

### FIRE PROTECTION

Paragraph 5.3.5.3 Color: Delete fire alarms. Keep fire alarm devices in red color or NFPA 72 requires colors.

### MECHANICAL

Paragraph 5.6.7 Non-Water Using Urinals does not apply to this Request for Proposal. Provide low flow urinals with 0.125 gpf flush valve.

Paragraph 5.8.3 is superceded by 6.11.10.

### ENERGY CONSERVATION

Paragraph 5.9.4 Solar Hot Water Heating: Add the following sentence: Provide analysis of solar panel locations and impact on architectural context. D-B firm shall receive approval by Base Civil Engineer for use and location of solar panels.

### SUSTAINABLE DESIGN

Paragraph 5.11.3 Optimize Energy Performance: Delete the following sentence; "For LEED-NC v2.2 projects you may substitute ASHRAE 90.1 2007 Appendix G in its entirety for ASHRAE 90.1 2004 in accordance with USGBC Credit Interpretation Ruling dated 4/23/2008."

Paragraph 5.11.5 Daylighting: Delete paragraph in its entirety. Project will not meet Daylighting requirements.

### CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

Paragraph 5.8.3.5 Bullet 1 Building Control Systems: Any IP network work, including access to existing networks shall be coordinated with the 633d Communications Squadron.

Paragraph 5.12 Construction and Demolition Waste Management: Use Specification Section 01 74 19.00 50, Construction and Demolition Waste Management, provided in Appendix TT for development of the Construction and Demolition Waste Management plan and preparation of the specification during Design in lieu of Section 01 57 20.00 10, Environmental Protection.

### 6.3. SITE PLANNING AND DESIGN

#### 6.3.1. General:

The new LO/CR Facility will be located directly south of and in line with the existing LO/CR facility. This will require the demolition of existing site items such as sidewalks, utilities, and GOV parking spaces in order to accommodate the proposed new Facility. A new rigid concrete apron will be installed adjacent to the existing apron that currently exists and will extend to the ancillary space between the existing hangar and the proposed hangar. New concrete sidewalks will be installed from all exit ways from the proposed new Facility and will be connected to the existing sidewalk along Flight Line Road. The GOV parking spaces that are to be demolished will be relocated to the south of the proposed hangar outside of the AT/FP standoff distance and a new trash dumpster pad and screen walls will also be added to the GOV parking space area. A new controlled access driveway will be installed from Flight Line Road to the new Facility so that deliveries of parts on pallets can be made more easily.

#### 6.3.2. Site Structures and Amenities

Site development shall include, but not be limited to:

6.3.2.1 No handicap parking is required for this facility. No additional POV parking is required. The only parking requirement is for six (6) GOV spaces.

6.3.2.2 One 12' x 16' concrete dumpster pad shall be provided, located within the GOV parking area. Concrete pad shall be a minimum of 8 inches thick on a 4 inch aggregate base course. Concrete shall extend a minimum of 20 feet in front of the dumpster to accommodate the trash truck front wheels. Dumpster screen wall enclosure will be provided. The screen wall enclosure will visually match or be constructed of materials to match the new facility exterior walls. The color will match the new facility exterior walls. A gate keeper, capable of holding the gates in an open position, and a locking mechanism will be integrated into the gate design.

6.3.2.3 Walks: Exterior concrete walks will be constructed as needed to accommodate the final project layout and will be shown on the site plan. Building entrances, main and secondary entrances, will be provided with a concrete pad and connecting concrete walk. A concrete walk will be provided from the building to the GOV parking lot. Concrete walk shall be a minimum of 4 inches thick on 4 inches base course. All sidewalks shall be a minimum of 6 feet wide. When connecting to existing sidewalks wider than 6 feet, new sidewalks shall match the existing sidewalk in width.

6.3.2.4 Contractor shall demolish all existing site features as necessary to construct new facility. See also demolition requirements detailed in Paragraph 6.17.

6.3.2.5 Contractor is responsible for all site improvements necessary to construct items outlined in Section 2.0 Scope.

6.3.2.6 Contractor is to coordinate all utility relocation requirements, capacities, shut downs if needed and availability with Langley AFB **633d Civil Engineering Squadron**.

6.3.3. Site Functional Requirements:

6.3.3.1. Stormwater Management (SWM) Systems.

6.3.3.1.1 The storm drainage shall be properly coordinated with the surrounding buildings to ensure that runoff does not cause damage to those buildings. Stormwater design shall be in accordance with the Virginia Stormwater Management Handbook and Virginia Stormwater Management Regulations. Treat sediment contaminated stormwater prior to discharge from the site. All stormwater calculations shall be based on a 10-year storm frequency and pipes shall be sized for full flow with a 2.5 fps minimum velocity of flow. See Section 6.16 for the required permits prior to construction. For any proposed land disturbance greater than 2,500 square feet, a Virginia Stormwater Management Program (VSMP) permit is required. See Section 6.16 for the required permits. In accordance with the VSMP permit, the contractor shall provide the Stormwater Pollution Prevention Plan (SWPPP).

6.3.3.1.2 This project will comply with the Energy Independence and Security Act (EISA). EISA Section 438 requirements apply to projects that Construct facilities with a footprint greater than 5,000 gross square feet, or expand the footprint of existing facilities by more than 5,000 gross square feet. The overall design objective for each project is to maintain predevelopment hydrology and prevent any net increase in storm water runoff. Project site design options shall be evaluated to achieve the design objective to the maximum extent technically feasible. The "maximum extent technically feasible" criterion requires full employment of accepted and reasonable storm water retention and reuse technologies (e.g., bio-retention areas, permeable pavements, cisterns/recycling, and green roofs), subject to site and applicable regulatory constraints. All site-specific technical constraints that limit the full attainment of the design objective shall be documented. If the design objective cannot be met within the project footprint, LID measures may be applied at nearby locations on DoD property. Langley AFB has a Low Impact Design Handbook that gives direction on the allowed LID measures on base, a copy can be found in Appendix NN. Whatever stormwater measures that are used cannot cause a Bird Air Strike Hazard (BASH). The Contractor is directed to review the Low Impact Development Measures that are allowed on Langley AFB in Appendix NN.

6.3.3.1.3 The Contractor shall ensure that work does not interrupt the flow of storm water nor interfere with the daily operations of the facility.

6.3.3.1.4 The Contractor will provide design calculations for the 10-year, 24-hour design storm that show the existing runoff, and provide control for increased runoff from the proposed improvements to the pre-development rate of discharge.

6.3.3.1.5 The Contractor shall utilize existing drainage outfalls from the site.

6.3.3.1.6 All materials shall be in accordance with VDOT Road and Bridge Standards latest edition or installation criteria. Culverts and storm pipes under paved areas shall be reinforced concrete with watertight joints.

6.3.3.1.7 There currently exist twin 30" reinforced concrete storm pipes that because of their location will most likely intersect with the southeast portion of the proposed hangar. These pipes will have to be relocated to avoid the new hangar. In addition, there is an abandoned 27" reinforced concrete storm pipe that will reside beneath the new hangar and office space. This pipe will have to be removed as part of the construction contract.

6.3.3.2. Erosion and Sediment Control

(a) This project will disturb more than 2,500 square feet of land and as such will require a storm water pollution prevention plan (SWPPP) and a Virginia Storm water Management Program (VSMP) General Permit for Discharges of Storm water from Construction Activities (Form DCR199-146) from the Virginia Department of Conservation and Recreation (DCR). The SWPPP must be completed and submitted to Base Stormwater for review prior to sending to DCR for their review and approval and prior to obtaining the General Permit.

(b) A SWPPP that uses BMP's for erosion and sediment control will be developed in accordance with the Virginia Stormwater Management Handbook. The Contractor shall install a stabilized construction exit, inlet controls, silt fencing and other BMP's in accordance with the handbook. The Contractor shall minimize tracking soil onto adjacent roadways. Contractor shall sweep roadways as necessary to remove tracked soil and dust.

#### 6.3.3.3. Vehicular Circulation.

6.3.3.3.1 The existing road structure will be utilized for vehicular circulation for entrance and exit to the construction area. The Contractor shall coordinate with Langley AFB Planning Department for the necessary security of access to the installation before beginning construction activities.

6.3.3.3.2 A six (6) space GOV parking lot shall be provided to replace the GOV parking lot demolished as part of this project. The parking lot shall conform to UFC guidelines and each space be provided with a 110V 15A receptacle in a weather proof enclosure within 30 feet of the parking spaces for plug in of the GOV's.

### 6.4. SITE ENGINEERING

#### 6.4.1. Existing Topographical Conditions

An existing topographic and utility survey of the site area is shown in Appendix J. This survey will not be a part of this contract. The Contractor will provide a digital topographic and utility survey for the site as part of their design and construction. The survey shall provide survey control points and a coordinate system, based on Virginia State Plane Coordinate System South Zone and North American Datum 1983 (1933)(HARN).

6.4.2. Existing Geotechnical conditions: See Appendix A for a preliminary geotechnical report.

A Preliminary Geotechnical Engineering Report has been completed, and is contained in Appendix A. For further information regarding the included geotechnical report and the Contractors requirements for completing a post-award final geotechnical evaluation report see Section 01 00 00 Paragraph 5.2.2.1 and Section 01 33 16, Design After Award, Paragraph 3.5.3. It is possible that site specific subsurface conditions encountered by the Offeror will differ from those appended herein. Therefore, it is the responsibility of the Offeror to establish a meeting with the COR immediately following the completion and evaluation of his site specific geotechnical exploration to outline any differences encountered that are not consistent with the information provided herein. Should those differences require changes in the foundation type, pavement and earthwork requirements proposed with the bid that result in more cost, these differences shall be clearly outlined for the meeting.

6.4.3. Fire Flow Tests See Appendix D for results of fire flow tests to use for basis of design for fire flow and domestic water supply requirements.

The Contractor shall be responsible for the fire flow test used in his design and construction.

#### 6.4.4. Pavement Engineering and Traffic Estimates:

6.4.4.1 Apron pavement shall be rigid concrete plain jointed with thickened edges, and be designed in accordance with UFC 3-260-02 for pavement thickness and pavement section using anticipated loads for a F-22A aircraft Type C traffic area and design life of a minimum of 20 years. Reinforcement is to be used at all inlets, manholes, cleanouts, door rails and structures in accordance with UFC 3-260-02. All joints in the access apron shall be in accordance with UFC 3-260-02 and the access apron shall at a minimum contain doweled construction joints, contraction joints, expansion joints and thickened edge joints. The new apron shall meet grade requirements of

UFC 3-260-01 Table 6.1. Pavement mix design shall be in accordance with UFC 3-250-04. The Contractor is responsible to provide the government with a complete detailed design with the first design submittal of the apron and hangar in accordance with UFC 3-260-02. In no case shall the thickness of the access apron and the hangar floor be less than 13" and the flexural strength of the concrete less than 650 psi.

6.4.4.2 The six (6) GOV parking spaces shall be 9' wide by 18' deep and the pavement design shall be in accordance with UFC 3-250-01FA and shall at a minimum consist of a 3" Asphaltic Surface Course over an 8" Aggregate Base.

6.4.4.3 The remaining asphalt in the new parking lot and service drive shall be in accordance with UFC 3-250-01FA and shall at a minimum consist of a 2" Asphaltic Surface Course over a 3" Asphalt Base Mix over an 8" Aggregate Base.

#### 6.4.5. Traffic Signage and Pavement Markings

Traffic signage and pavement markings shall be in accordance with applicable UFC Manual.

#### 6.4.6. Base Utility Information

An existing foam pumping station exists southeast of the existing LO/CR facility. The foam pumping station collects the high expansion foam from the existing facility and discharges via a 10" foam force main that runs on the south side of the existing facility. The pumping station shall remain in its current location but the Contractor will relocate the existing 10" foam force main around the proposed LO/CR addition. The location of the lift station is such that it should not interfere with the proposed operations of this facility and to protect it from damage concrete bollards will be placed around it.

The new LO/CR foam will be collected by two 10" gravity ductile iron pipes and connected into the existing foam pumping station.

There is one known electric line that is in conflict with proposed LO/CR Facility that will have to be relocated. The Contractor will coordinate with the existing facility for shut down and splicing.

An 8" water line exists on the south side of the existing LO/CR facility in direct conflict with the proposed LO/CR addition. This line provides fire flow to existing fire hydrants located outside the existing hangar. The Contractor will relocate this line around the new LO/CR facility. The Contractor will remove one existing fire hydrant located to the southeast of the existing facility and install new hydrants to provide adequate fire protection for the new addition.

Since the new facility will not connect to the high expansion foam system within the existing building, the Contractor will install a new 10" water line along the west side of the existing hangar facility between the existing hangar facility and Flight Line Road from an existing 12" water main located on the north side of the existing hangar facility to the High Expansion Foam room inside the new LO/CR Facility.

The existing domestic water services will be extended to the new facility from the existing mechanical room within the facility.

An existing sanitary sewer lift station exists southeast of the existing LO/CR facility. The lift station collects the sanitary waste from the existing facility and discharges via a 3" sanitary sewer force main that runs on the south side of the existing facility. The lift station shall remain in its current location but the Contractor will relocate the existing 3" sanitary sewer force main around the proposed LO/CR addition. The location of the lift station is such that it should not interfere with the proposed operations of this facility and to protect it from damage, concrete bollards should be placed around it.

The Contractor will install a new 4" sanitary sewer lateral from the new LO/CR facility and connect into the existing sanitary sewer lift station. The existing sanitary sewer lift station is adequately sized to handle the additional flow

from this project.

An existing 4" natural gas line crosses Flight Line Road and then turns to the north along the west face of the existing hangar facility. The Contractor will use this line to provide gas to the new LO/CR Facility. This line is owned by Virginia Natural Gas (VNG), the Contractor shall coordinate with VNG for extension of their utility to serve this project.

Base Cable TV is not applicable to this project.

There currently exists a 400 strand fiber and a 1,400 pair copper communications line and manholes along the east side of the new LO/CR facility. Under no circumstances is this communication line to be interrupted, relocated or spliced. One of the existing manholes for this fiber line will be located outside of the new LO/CR hangar within the proposed new apron. This location will be acceptable but the Contractor shall modify the lid to withstand loads from aircraft. The Contractor shall protect the existing north/south communication line at all times during the construction of the new facility.

An existing communication line starts from the existing manhole located outside of the new hangar and runs along the south side of the existing building to room 143 in the existing facility. This line is in conflict with the proposed hangar construction and the Contractor will install a new concrete encased communication duct bank from the existing manhole to the new facility within the new apron area and then run overhead within the new facility back to existing room 143.

#### 6.4.7. Cut and Fill

6.4.7.1 The site currently drops off away from the existing apron to existing drainage inlets located south of the site. The new LO/CR Facility shall match the existing finished floor elevation for both the hangar portion and for the administration portion of the facility.

6.4.7.2 Any excavated material from the project that cannot be re-used on site, or has petroleum contamination must be trucked off base and disposed of properly in accordance with the Base Environmental Special Conditions (Appendix AA).

6.4.7.3 Any earth material that is trucked onto the base must have proper documentation of the source in accordance with the Base Environmental Special Conditions (Appendix AA).

#### 6.4.8. Borrow Material

No borrow is available on the installation. All borrow material shall come from a suitable source off base. Any borrow material that is trucked onto the base must have proper documentation of the source in accordance with the Base Environmental Special Conditions (Appendix AA).

#### 6.4.9. Haul Routes and Staging Areas

6.4.9.1 The Contractor shall not block any fire roads or fire access and shall secure his lay down area with 6' or 8' high chain link fence with brown screening.

6.4.9.2 The haul route on base shall be by entering the LaSalle Ave. gate, turning left onto Elm St, turning right onto Sweeney Blvd. and turning left onto Hickory St. Distance from LaSalle Ave. gate to the project site is approximately 2 miles. Please note, part of the haul route requires access to the controlled flight line so the Contractor must submit to a FOD check and all drivers shall obtain a Flight Line Drivers License AF 483 to be given by the base. The haul route off base shall consist of exiting the flight line via Hickory St. and turn right onto Sweeney Blvd. and go directly out the West Gate at the end of Sweeney Blvd. Exiting distance is approximately 1 mile. Entrance only to Langley AFB will not be allowed via the King Street and West Gate gates unless otherwise directed by the base. The Contractor is hereby informed that on or around July 2011 the haul route in and out will only be through a new West Gate to be located on Sweeney Blvd.



6.4.9.3 The Contractor must restore all disturbed or damaged areas to pre-construction conditions in accordance with Section 01 57 20.00 10 Paragraph 3.12.

6.4.9.4 Any construction equipment that will be higher than 150 feet must obtain a Temporary Construction Waiver which is only approved by the Base Commander and takes 30-45 days to obtain.

6.4.9.5 All construction vehicles that will need to access the site via Flightline Rd. will need to obtain flight line vehicle passes.

6.4.9.6 The contractor is required to coordinate with Base Civil Engineering for the permits specified in Section 01 30 00.10 50 Paragraphs 1.6.5 and 1.6.6.

#### 6.4.10. Clearing and Grubbing:

There are no existing trees or shrubs in the way of the proposed construction. Clearing and grubbing of the site include stripping of pavements, topsoil, organic materials, debris, and other detrimental materials that may interfere with providing suitable subgrade for the proposed construction. Note that the provided preliminary geotechnical report states that the topsoil encountered in the borings is approximately 2-inches thick. In addition, suspected fill layer was encountered in the upper 3 to 6-feet. The Offeror and his or her professional geotechnical engineer consultant are responsible for determining the depth of stripping and/or over-excavation necessary to provide a suitable subgrade.

#### 6.4.11. Landscaping:

The current LO/CR facility does not have any shrubs or trees around it and as such no new plantings are proposed for this project. Irrigation is not required for this project.

#### 6.4.12. Turf:

All lawn areas will be seeded in accordance with the following procedures:

The contractor is to have the soil tested for pH, herbicides, organics, salts.

If heavily weed infested, the contractor is to apply a non-selective herbicide at least 10 days prior to seeding.

If recommended by the soil test results, the contractor is to adjust the pH with pelletized lime at the recommended rate.

The contractor is to prepare the seedbed by cultivating the soil to a 4-inch depth.

The seed mix is to consist of 70% Bermuda : 30% fescue from Virginia certified seed sources. Absolutely no perennial or annual rye seed. No German Millet shall be used.

A starter fertilizer shall be incorporated into the soil.

It is preferable to install the seed with a seed drill, however hydroseeding can be used as an alternate. In any case the soil must still be cultivated to facilitate root development.

Irrigate as needed to facilitate germination and facilitate the establishment of the grass and roots.

It is preferable to seed prior to July 1st to ensure germination.

If area does not receive jet blast or prop wash, an erosion control mat such as VDOT EC-2 may be used to accelerate germination and retain soil moisture. Mat must be securely installed to avoid becoming a FOD hazard. Remove as soon as grass height reaches 2-3 inches. All stakes and staples must be accounted for.

Provide initial mowing at 3-inch height to encourage tillering. Coordinate with mowing contractor. Coordinate with 1 FW/SE and USDA-WS at (757) 764-5357.

## 6.5. ARCHITECTURE

6.5.1. General: To the maximum extent possible within the contract cost limitation, the buildings shall conform to the look and feel of the architectural style and shall use the same colors as adjacent facilities as expressed herein. The Government will evaluate the extent to which the proposal is compatible with the architectural theme expressed in the RFP during the contract or task order competition. The first priority in order of importance is that the design provides comparable building mass, size, height, and configuration compared to the architectural theme expressed herein. The second priority is that design is providing compatible exterior skin appearance based upon façade, architectural character (period or style), exterior detailing, matching nearby and installation material/color pallets, as described herein.

### 6.5.2. Design

6.5.2.1. Appendix F is provided "For Information Only", to establish the desired site and architectural themes for the area. Appendix F identifies the desired project look and feel based on Langley AFB's Installation Architectural Theme from existing and proposed adjacent building forms; i.e. building exterior skin, roof lines, delineation of entrances, proportions of fenestration in relation to elevations, shade and shadow effects, materials, textures, exterior color schemes, and organizational layout.

6.5.2.2. The design should address Langley AFB's identified preferences. Implement these preferences considering the following:

- (a) Achievable within the Construction Contract Cost Limitation (CCL)
- (b) Meets Milestones within Maximum Performance Duration.
- (c) Achieves Full Scope identified in this Solicitation
- (d) Best Life-Cycle Cost Design
- (e) Meets the Specified Sustainable Design and LEED requirements
- (f) Complies with Energy Conservation Requirements Specified in this RFP.

6.5.2.3. Priority #1. Visual Compatibility: Facility Massing (Size, Height, Spacing, Architectural Theme, etc.) Exterior Aesthetic Considerations: The buildings massing, exterior functional aesthetics, and character shall create a comprehensive and harmonious blend of design features that are sympathetic to the style and context of the Installation. The Installation's intent for this area is:

The facility is located in the Flight Line Area of the base. The addition to the LO/CR Facility shall exactly match the look and feel of the architectural style of the existing facility and shall use exactly the same colors and materials of the existing Building 361 and as expressed within the Langley Air Force Base Design Compatibility Guidelines. Site and Architectural conceptual drawings that meet this objective are shown in Appendix J.

6.5.2.4. Priority #2. Architectural Compatibility: Exterior Design Elements (Materials, Style, Construction Details, etc.) Roofs, Exterior Skin, and Windows & Door Fenestrations should promote a visually appealing compatibility with the desired character while not sacrificing the integrity and technical competency of building systems.

6.5.2.5. See Appendix F for exterior colors that apply to Architectural character at Langley AFB. The manufacturers and materials referenced are intended to establish color only, and are not intended to limit manufacturers and material selections.

6.5.2.6. Additional architectural requirements:

- (a) Install fall protection anchor points on all roofs with a slope greater than 2:12
- (b) The exterior of the building shall exactly match the existing facility exterior utilizing a precast concrete water table and brick to match the height on the existing building and insulated metal wall panels above the brick to the eaves. The concrete water table shall extend below the exterior finished grade.
- (c) Screen walls that match the building's walls shall be used to screen equipment yards for the facility. Screen walls shall be protected to meet all AT/FP requirements.
- (d) The roof above the ancillary spaces should tie in to the existing to provide the appearance of a single continuous structure. The roof of the paint hangar bay shall match the roofs of the existing paint hangar bays and wash bay.
- (e) Additional information for each space is provided in the Room Data Sheets located in Appendix LL.
- (f) The new hangar construction shall meet or exceed clearance requirements of UFC-3-260-01 Table 8.2.
- (g) The hangar floor shall be designed per UFC 3-260-02 for anticipated loads and design life.

#### 6.5.3. Programmable Electronic Key Card Access Systems:

[Not Supplied - PS\_Architecture : PROGRAMMABLE\_KEY\_CARD]

#### 6.5.4. INTERIOR DESIGN

All interior design shall be in accordance with the Langley Air Force Base Design Compatibility Guidelines and coordinated and approved by the Langley AFB Base Architectural Compatibility Officer in Langley AFB 633d CES.

Interior building signage requirements:

Interior signage shall match existing building signage in style, color and size.

#### 6.6. STRUCTURAL DESIGN

6.6.1 STANDARDS AND CODES: The structural design shall conform to APPLICABLE CRITERIA.

6.6.2 GENERAL: The structural system must be compatible with the intended functions and components that allow for future flexibility and reconfigurations of the interior space. Select an economical structural system based upon facility size, projected load requirements and local availability of materials and labor. Base the structural design on accurate, site specific geotechnical information and anticipated loads of the building types and geographical location. When modular units or other pre-fabricated construction is used or combined with stick-built construction, fully coordinate and integrate the overall structural design between the two different or interfacing construction types.

#### 6.6.3 CLIMATIC AND EARTHQUAKE LOADS

- (a) Ground Snow Load: 15 psf
- (b) Wind Speed: 110 mph
- (c) Frost Penetration: 9 inches
- (d) Seismic Data:  $S_s = 0.15g$ ;  $S_1 = 0.08g$

## 6.7. THERMAL PERFORMANCE

The hangar addition shall conform with the minimum thermal performance criteria established by the International Energy Conservation Code. The thermal performance of the hangar addition shall also conform to LEED certification requirements.

## 6.8. PLUMBING

6.8.1 Standards and Codes: The plumbing system shall conform to SECTION 01 10 00 PARAGRAPH 4.0, APPLICABLE CRITERIA and to SECTION 01 10 00, PARAGRAPH 6.0, PROJECT SPECIFIC REQUIREMENTS.

6.8.2 Precautions for Expansive Soils: Where expansive soils are present, the design for underslab piping systems and underground piping serving chillers, cooling towers, etc, shall include features to control forces resulting from soil heave. Some possible solutions include but are not necessarily limited to, features such as flexible expansion joints, slip joints, horizontal offsets with ball joints, or multiple bell and spigot gasketed fittings. For structurally supported slabs, piping should be suspended from the structure with adequate space provided below the pipe for the anticipated soil movement.

6.8.3 Corrosion Protection: All piping that will be installed in an environment that supports galvanic reaction shall be protected from corrosion in accordance with the standards and recommended practices of the National Association of Corrosion Engineers.

6.8.4 Identification Labeling: All plumbing systems shall have permanent labeling on pipe and equipment. The location of all items requiring manual operation, service, or inspection shall have a mark on the primary access, e.g.: an engraved or stamped label on the nearest T bar grid or access door.

6.8.5 Refer to 6.4.6 Base Utility Information for building utilities.

6.8.6 Provide new meter with recording/reporting capabilities on the existing water service entering the building in Room 118.

6.8.7 Provide new gas meter with recording/reporting capabilities on the new gas service entering the building.

6.8.8 In addition to the location of floor drains noted in 5.6.6, provide floor drains in the Toilet, Showers, Laundry, and HEF spaces. Provide trench drain in the Paint Hangar discharging to the HEF collection system.

#### 6.8.9 Compressed Air System

A. Recommission existing air compressor Ingersoll Rand Model EP250, and refrigerated air dryer Ingersoll Rand thermo Star Model TS120C.

B. Furnish and install new compressed air piping system from existing Air Compressor Room to new Hangar Facility as herein specified.

C. The average compressed air device requires 30 CFM of compressed air at 90 psig to operate and the average number of devices in operation per Hangar bay is 6 devices.

6.8.9.1 PIPING MATERIALS: Provide piping materials as hereinafter specified for Copper Tube: **ASTM B 88, Type K or L** seamless, drawn-temper, water tube.

6.8.9.1.1 Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.

6.8.9.1.2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.

6.8.9.1.3 Copper Unions: ASME B16.22 or MSS SP-123.

6.8.9.1.4 Press-Type Fittings, **NPS 2** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Viega; Plumbing and Heating Systems.

2) <Insert manufacturer's name.>

6.8.9.1.5 Press-Type Fittings, **NPS 2-1/2 to NPS 4**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Viega; Plumbing and Heating Systems.

2) <Insert manufacturer's name.>

6.8.9.1.6 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (**150 PSIG** OR LESS)

A. Pipe **NPS 2** and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Lift Check Valves: Class 125, bronze disc.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, NRS.

B. Pipe **NPS 2-1/2** and Larger:

1. Iron Valves, **NPS 2-1/2 to NPS 4**: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, stainless-steel disc.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Gate Valves: Class 125, NRS.

## 6.8.9.1.7 MOISTURE TRAPS:

## A. Qualities:

1. Air actuated ball valve for discharge control.
2. Float and magnet to initiate discharge.

## 6.8.9.1.8 QUICK COUPLINGS:

## A. Qualities:

1. Heat-treated alloy steel, cadmium plated, U-packer seal, metal-to-metal stop for compression seal.

## 6.8.9.1.9 PRESSURE REGULATING VALVE:

## A. Refer to the Piping Specialties Section of this Specification for additional information.

## B. Qualities:

1. Direct acting pressure valve, cast bronze body, phosphor bronze regulating diaphragm with stainless steel seat and Teflon disc, stainless steel main spring, 200 PSI rated.

## 6.8.9.1.10 SAFETY VALVES:

## A. Safety valves shall be in accordance with the requirements of Section VIII of the ASME Boiler and Pressure Vessel Code.

## B. Safety valves shall have bronze bodies, screwed ends and be equipped with a test lever.

## C. Seats are to be stainless steel/Viton A.

## 6.8.9.1.11 PIPING METHODS:

## A. At each compressed air supply, provide a pressure reducing station and moisture trap.

## 6.8.9.1.12 MOISTURE TRAPS:

- A. Provide traps on air dryers, upstream of the air dryer and at low points in the piping.
- B. Traps shall be installed drip leg and provide with a manual by-pass valve.

#### 6.8.9.1.13 PRESSURE REDUCING STATIONS:

- A. Pressure reducing stations shall include high and low pressure gages, needle valve and shut-off valves. Provide a three-valve manual by-pass assembly for each reducing valve station.

#### 6.8.10 Breathing Air System

##### A. Breathing Air System:

- 1. Furnish and install a breathing air system to provide uninterrupted delivery of breathing-quality air (mask air) that meets ANSI Type 1, Grade D standards.
- 2. The breathing air system consists extending breathing air piping from an oil free air compressed source (existing), new purifier, filters, moisture drains, pressure regulators, controls and miscellaneous appurtenances necessary to provide a complete breathing air system. All components shall be compatibly sized to provide the required capacity. Breathing air devices are 3M 600 DIN Series.

#### 6.8.10.1 QUALITY ASSURANCE:

##### A. Reference Standards:

- 1. Equipment shall comply with the practices, methods and standards promulgated by the societies and associations listed in the Referenced Standards of the General Provisions Section of this Specification and as listed below:
  - a. ANSI - Compressed Gas Association Commodity Specification G-7.1-1989 for Grade D Breathing Air.
- B. Compliance to the above shall not relieve the Manufacturer/Contractor (Supplier) from complying with any requirements that may be in excess of, but not contrary to, the above-mentioned codes and standards.

#### 6.8.10.2 PIPING MATERIALS:

- A. Pipe, fittings, general purpose type valves, and other basic materials used in this system shall be as scheduled.

#### 6.8.10.3 QUICK COUPLINGS:

- 1. Couplings used on breathing air-breathing supplies shall not be compatible with couplings in use at the facility for other systems, such as compressed air or natural gas. Provide couplings that are compatible with couplings presently in use for breathing air .

#### 6.8.10.4 MOISTURE TRAPS:

##### A. Qualities:

- 1. Air actuated ball valve for discharge control.
- 2. Float and magnet to initiate discharge.

## 6.8.10.5 FILTERS:

- A. Provide duplexed, activated carbon element filters to deliver odor and taste free air to the pipeline system at a maximum of one-PSI pressure drop at flow conditions specified. See Article 4.1 for capacity.

## 6.8.10.6 PANEL

- A. Provide Breathing Air System Monitoring Panel with the following functions:

- a. Control Power On light
- b. Alarm Silence pushbutton
- c. Pressure Below 75 PSIG light
- d. Pressure Above 110 PSIG light
- e. Air Compressor Alarm light
- f. Pressure Drop Above 2 PSIG light
- g. Dew Point Above 39 Deg. F light
- h. Carbon Monoxide Above 10 PPM light
- i. High Outlet Temperature light

## 6.8.10.7 PIPING METHODS:

- A. All joints to be brazed or soldered with nitrogen flowing in the pipe to prevent internal corrosion.
- B. Grade piping down in direction of flow.
- C. Install lockable branch-isolating valves.
- D. Provide system isolation and sample valves downstream of filters for equipment certification.

## 6.8.10.8 PIPE MARKING/LABELING:

- A. All piping shall be marked in accordance with the Mechanical Identification of this Specification.

## 6.8.10.9 CLEANING:

- A. Blow piping system clear with compressed air of 100 psig at 40-degree dew point in accordance with PSC-10.05.

## 6.8.10.10 TESTING AND CERTIFICATION:

- A. Test system with compressed air at 150 psig at 40-degree dew point for a 24-hour period. Check for loss of pressure.



B. Check air quality with suitable analyzers to meet ANSI Type 1, Grade D Specifications for Breathing Air and certify unit performance for delivered air - oxygen, oil, particulate and carbon dioxide content before placing in service. Provide a certificate of compliance.

#### 6.8.10.11 Domestic Hot and Cold Water Systems

1. Extend existing domestic hot and cold water piping systems to new plumbing fixtures in Toilet Rooms, Janitor's Closet and hangar Bay.

#### 6.8.11 Paint Spray Bay Vacuum System

1. The existing vacuum system manufactured by Transmataic, Inc. that serves Environmental systems, the two existing Paint Spray Bays is sized to accommodate a third Paint Spray Bay. Extend new vacuum piping to the vacuum connection locations shown on the Drawings.

2. Provide Vacuum System Control and Monitoring Panel with the following functions:

- a. Start pushbutton
- b. Stop pushbutton
- c. Fault indicator light
- d. Run indicator light

### GENERAL TECHNICAL REQUIREMENTS

6.8.12 GENERAL: This paragraph contains general technical requirements. Refer to Section 01 10 00, Paragraph 6.0, PROJECT SPECIFIC REQUIREMENTS, for additional facility-specific requirements.

6.8.13 Product & System Performance Record: Provide Components and equipment that are

"standard products" of a manufacturer, which is regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as having demonstrated two or more years of trouble free service in commercial or industrial. The 2-year manufacturer's experience shall include applications of components and equipment under similar circumstances, environmental conditions and of similar size. A product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures must satisfactorily complete the 2-years. Products having less than a 2-year field service record will be

acceptable if a certified record of trouble free service or field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.

6.8.14 Equipment items shall be supported by a service organization.

6.8.15 Asbestos and asbestos-containing products shall not be used.

6.8.16 Energy Conservation: Design of the building, including the building envelope, HVAC

systems, power, and lighting systems shall meet ASHRAE 90.1-2004 and, to the extent of life cycle cost effectiveness, achieve energy consumption levels that are at least 30% below the level of the baseline building in accordance with ANSI/ASHRAE/IESNA Standard 90.1-2004, Appendix G. One difference between LEED® and the Energy Policy Act of 2005 is how process loads are treated. LEED® requirements  $\text{Percentage Improvement} = 100 \times (\text{Baseline building consumption} - \text{Proposed building consumption}) / (\text{Baseline building consumption} - \text{Receptacle and process loads})$  Sustainability shall be a consideration throughout the process of project development from inception. Selection of solutions and technologies to achieve the above energy performance requirements shall be based on life cycle cost analysis.

6.8.17 Site Access: The D-B Contractor shall contact the Security Office site access, workmen security clearances, ID badges and vehicle passes. Construction access shall be from the construction entrance-alternative routes may be required.

6.8.18 Construction Site Security: Security of the construction site, including Contractor lay-down areas and staging areas, shall be the responsibility of the DB Contractor.

## 6.9. SITE ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

### 6.9.1 APPLICABLE CRITERIA

UFC 3-501-01 Electrical Engineering

UFC 3- 530-01 Design: Interior and Exterior Lighting and Controls

UFC 3-550-01 Exterior Electrical Power Distribution

UFC 3560-01 Electrical Safety, O&M

6.9.2 Relocate the existing 22kV primary underground distribution in concrete encased duct bank from underneath proposed construction, complete with new manhole.

6.9.3 Provide 5kV feeder to new chiller with a new 5kV power draw-out circuit breaker in existing SES-1.

### 6.9.2 TELECOMMUNICATIONS SYSTEMS

### 6.9.2.1 General Requirements and Coordination

(a) The communications infrastructure system at Langley has not been privatized and is managed by the Langley 633d Communication Squadron (633 CS/SCXP). The DB Contractor will contact and coordinate all communications service connections with (633 CS/SCXP). (633 CS/SCXP) point of contact for this project is Dwayne Weston at (757) 764-7199, [dwayne.weston@langley.af.mil](mailto:dwayne.weston@langley.af.mil).

(b) All design work shall be performed by a Registered Communications Distribution Designer (RCDD) with a minimum of 5 years experience in the application of related telecommunications systems of outside plant and interior building cabling systems. Provide evidence to certify designer's qualifications.

(c) All communications systems outside plant (OSP) and Building Cabling System (BCS) shall be designed and constructed in accordance with the Langley AFB Telecommunications Building Cabling Systems Standards document or as directed by the (633 CS/SCXP) requirements.

(d) The DB Contractor shall coordinate communication infrastructure design and construction requirements with the (633 CS/SCXP) and Site Engineer through the Corps of Engineers, Resident Engineer or other COE POC as designated. Construction drawings and specifications shall comply with the Langley AFB Telecommunications Building Cabling Systems Standards document, UFC 3-580-01 and ETL 02-12.

The DB Contractor is responsible for the design and construction of the OSP communications systems and Building Cabling System. The DB Contractor shall engineer, furnish, install, secure, and test (EFIS&T) the telecommunications and information technology infrastructure and make operational.

### 6.9.3 CONDUITS AND FITTINGS

6.9.3.1 All exterior power and communications service conduits will be 4 inch or larger PVC. Quad type conduits will be 1-1/4 inch PVC. Contractor may use inner duct configuration with nine cell fabric inner duct internal conduits in-lieu of the quad conduit configuration. Conduits installed above grade on poles will be galvanized rigid steel (RGS). Fittings for steel conduit will be steel threaded or compression type. Screw, clamp or other types of fittings are not acceptable.

### 6.9.4 TRACER WIRE AND MARKER TAPE

6.9.4.1 All non-metallic utility and storm drain lines will have # 12 AWG TW (thermal-weather resistant) insulated, solid copper wire, installed parallel with and 6 inches above the utility for the reception of a locator transmitter signal. In addition, natural gas lines will have marking tape placed in the trench 6 inches below finish grade.

6.9.5 TELECOMMUNICATION SERVICE: The project's facilities must connect to the installation's telecommunications (voice and data) system through the outside plant (OSP) telecommunications underground infrastructure cabling system per Langley AFB Telecommunications Building Cabling Systems Standards document in Appendix EE. Connection to the OSP cabling system shall be from the buildings Entrance Facility existing Room 143.

6.9.6 EXTERIOR COMMUNICATIONS: Communications service to the building shall be both fiber optic and copper cables enclosed in underground 4 inch conduit ductbanks; one 4 inch conduit for the copper cable, one 4 inch conduit for fiber optic cable, and two 4 inch conduit expansion. Three, 3 cell fabric innerducts shall be provided and installed in the 4 inch fiber optic conduit. The 4 inch conduit bank shall be joined to the installation ductbank system at the location described in paragraph SITE COMMUNICATION SYSTEMS - OSP and extended to the

existing communication MH-178. Existing fiber patch panels and Protection Entrance Terminals (PET) shall be furnished for incoming outside plant cables. The incoming OSP Category 3 Copper cable shall terminate on the building PET. The incoming fiber optic cable shall terminate in a existing 19" wide rack mounted fiber optic patch panel. The patch panel shall have ST type adaptors and connectors.

#### 6.9.7 SITE COMMUNICATION SYSTEM -OSP

6.9.7.1 The DB Contractor shall engineer, furnish, install, secure, and test (EFIS&T) the telephone and data telecommunications and information technology infrastructure communications services to include but not limited to the installation of outside cabling, protected entrance terminals, patch panels, splice enclosures manholes, handholes, conduit, ductbank system and all other required materials to construct the OSP.

6.9.7.2 All outside plant work will be in accordance with the Langley AFB Telecommunications Building Cabling Systems Standards document and ETL 02-12. See Appendix FF.

6.9.7.3 For coax cable to support community access television (CATV). None is required for this project.

6.9.8.4 For copper cable to support telephones / security; The DB contractor shall install an underground conduit from the existing MH-178 located right in front of the new hangar. From manhole location, provide/reuse a 200 pair 24 AWG copper cable terminated on a existing building Protected Entrance Terminal mounted on a fire rated backboard.

6.9.7.5 For fiber optic cable to support LAN / Data; The DB contractor shall install an underground ductbank system from existing manhole MH-178 located right on front of the new hangar. Provide 12 strands of single mode FOC from the Telecommunications Entrance Facility (TEF) in the existing building by way of the manhole. Terminate fiber optic cable using ST connectors in a existing rack mounted fiber patch panel.

6.9.7.6 New communication ductbank shall be constructed using a minimum of four (4) 4" PVC conduits, concrete encased. Provide (3) 3 cell fabric innerducts in one conduit for routing fiber optic cable.

6.9.7.7 The new hangar door track is to be aligned such that it does not pass over the existing communications manhole.

6.9.7.8 All non-metallic communication conduits and ductbanks will have #12 AWG TW (thermal-weather resistant) insulated, solid copper wire, installed parallel with and 6 inches above the utility for the reception of a locator transmitter signal.

#### 6.10. FACILITY ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

##### 6.10.1 APPLICABLE CRITERIA

## 6.10.1.1 REFERENCES

UFC 3-501-01 Electrical Engineering

UFC 3-520-01 Interior Electrical Systems

UFC 3- 530-01 Design: Interior and Exterior Lighting and Controls

UFC 3560-01 Electrical Safety, O&M

NFPA 69 Standard on Explosion Prevention Systems

NFPA 70E Standard for Electrical Safety in the Work Place

NFPA 77 Recommended Practice on Static Electricity

NFPA 409 Standard on Aircraft Hangars

NFPA 410 Standard on Aircraft Maintenance

6.10.1.2 Power Service. In the electrical room provide a 1000A, 480Y/277V, 3 phase distribution switchboard fed from SES-2.

6.10.1.3 Lightning Protection System and Transient Voltage Surge Protection (TVSS). Design shall be in accordance with NFPA 780 and referenced criteria. Provide TVSS at all switchboards, panelboards, control panels, etc.

6.10.1.4 Provide power receptacles in conjunction with the proposed equipment, furniture layouts, and to each workstation. Provide a duplex receptacle adjacent to each voice/data and CATV outlet.

6.10.1.5 Special power outlets and feeders to workbenches, maintenance area, HVAC, and paint booth. Coordinate with the user for government furnished equipment and the manufacturer of HVAC equipment and the paint booth.

6.10.1.6 Hazardous locations shall be clearly defined on the drawings based upon the intended use of the facility and applicable criteria. Receptacles, devices, equipment, and wiring in hazardous locations shall be UL listed for the application and installed in accordance with the NFPA code. The paint booth will be classified as Class I, Div. 1, from under the floor to ceiling and wall to wall. Conduit shall not be through any hazardous area except where absolutely necessary.

6.10.1.7 The paint bay shall have an average illumination level of 100 footcandles at the floor, average to minimum ratio of 3:1, and maximum to minimum ratio of 10:1. T5HO, 5000K, and 82+ CRI lamps shall be used. Provide low voltage controls for three or four (3 or 4) levels of illumination. Provide wall mounted T5HO luminaires

to illuminate under the wings and fuselage with upper glare shields and separate low voltage controls for three or four (3 or 4) levels of under wing illumination.

6.10.1.8 Illumination levels in other areas of the facility shall be in accordance with the UFC's.

## **TELECOMMUNICATIONS**

### 6.10.9 TELECOMMUNICATIONS ROOMS (TR):

6.10.9.1 No new rooms will be needed. Will utilize existing Telecommunication Room # 143.

### 6.10.10 INTERIOR PATHWAY

6.10.10.1 Trapeze or cantilever wall mounted basket style cable tray shall be provided as the horizontal serving pathway to support Category 6 UTP cabling to work area outlets. All work area outlets will be served with a 1" conduit from the cable tray to the outlet box.

### 6.10.11 TELEPHONE and LOCAL AREA NETWORK (LAN)

6.10.11.1 Building shall be pre-wired for voice, data systems. All voice / data pre-wiring shall be plenum rated Category 6 UTP cable terminated on 8P8C Category 6 jacks at outlet locations and on 8P8C Category 6 patch panels located in the communications room. Category 6 modular jacks shall terminate using T-568B standard.

6.10.11.2 Voice communications will terminate on 66 blocks mounted to a plywood back board adjacent to the incoming protected entrance terminal blocks. Cross connect wiring between blocks will be by others and authorized by (633 CS/SCXP) to meet requirements of the Langley AFB Telecommunications Building Cabling Systems Standards document.

6.10.11.3 Data communications will terminate on 8p8c Category 6 patch panel, following T-586B standards. Building fiber optic cable will terminate on a patch panel, on 19 inch floor mounted standard rack. Terminate cables with 'ST' connectors at the building service entrance.

6.10.11.4 Communications faceplates shall match the color and same type material as the electrical faceplate (Plastic or Stainless Steel).

### 6.10.12 TELECOMMUNICATIONS OUTLETS

6.10.12.1 Telecommunications outlets shall conform to functional purpose of the various spaces within the facility as modified by user special operational requirements per Langley AFB Telecommunications Building Cabling Systems Standards document. Standard for this facility will be four (4) Category 6 cables.

6.10.12.2 Wall outlets shall be provided for administrative work area and offices consist of data and voice connections at two locations minimum.

6.10.12.3 No Wireless Access Point outlets will be needed for this project.

6.10.12.4 A wall telephone outlet with a single jack shall be provided in all common areas, mechanical room, electrical room, communications room.

6.10.13 COMMUNITY ANTENNA TELEVISION (CATV) None required for this project.

6.10.14 WHITE NOISE SYSTEM

6.10.14.1 DB contractor is required to extend the existing (White Noise) system located in the existing building Room 120 to cover the new paint hanger office area. Provide additional amplifier as need to accommodate the additional speakers.

#### 6.10.15 ELECTRONIC SECURITY SYSTEMS

6.10.15.1 Intrusion Detection System (IDS): An intrusion detection system shall be CFCI consisting of, but not limited to conduit, boxes, cabling, Balanced Magnetic Switches (BMS), sensors, alarm horns, system enclosure, keypads, electronics and software for a complete working installation. The system shall connect to the base central monitoring station. The CFCI (Contractor Furnished Contractor Installed) IDS shall provide door monitoring and motion sensing as needed on, and within the building. The system shall interface with the access control and CCTV system to allow automatic monitoring and recording of unauthorized entries into the building. IDS shall be designed and installed according to UFC 4-021-02NF.

6.10.15.2 Access Control System (ACS): An access control system shall be CFCI consisting of conduit and boxes and wiring at exterior entrance and secured interior doors. The GFGI (Government Furnished Government) Installed ACS will consist of, but not limited to proximity card readers, keypads, cabling, electronic strikes, magnetic locks and head end equipment.

6.10.15.3 A CCTV distribution system shall be CFCI consisting of conduit, boxes, wiring and cameras. CFCI cameras will be located to monitor necessary security. Camera locations shall be provided in the new hangar. Cameras on the outside of the building will monitor entrances and exits. CCTV power and signal cables shall be routed to the communications room in conduit and terminate at the backboard. The new CCTV system shall interface with the existing CCTV system.

6.10.15.4 There is an existing security system that will need to be extended for this project the following information is from the existing system. Advance Control Concepts Inc. HYPERLINK "[www.adv.control.com](http://www.adv.control.com)"[www.adv.control.com](http://www.adv.control.com) (850) 434.2050, (888) 409.2224. DSX Access System Inc. (800) 346.5288 (DSX-1040PDP)

6.10.15.5 (Option #1) Security modifications (IDS / ACS) will be required on entrance and exits into the two existing Paint Hangar Bays. Security modifications to include man door and over head garage doors leading into each paint hanger booth. All conduit and boxes are to be installed back to the main control panel. Surface mounting of infrastructure is acceptable but not preferred. The new paint hanger booth will have these doors secured as part of the scope of work. If the doors are not compatible with the new security requirement they will need to be replaced.

#### 6.11. HEATING, VENTILATING, AND AIR CONDITIONING

#### HEATING, VENTILATING, AND AIR CONDITIONING

##### 6.11.1 General Requirements:

#### 6.11.1.1 Ambient Design Dry and Wet Bulb: The HVAC cooling design

shall be based on the 1.0 percent cooling dry bulb (DB) temperature which is 91degrees F.  
and the 1.0 percent mean coincident wet bulb (MCWB) temperature which is 77degrees F.  
The heating design shall be based on the 99 percent heating (DB) temperature which is 24.  
degrees F.

#### 6.11.1.2 Interior Design Conditions:

Inside design shall be based on design criteria as follows:

Paint Spray Bay: Paint spray applications parameters are 65°F - 85°F, 40% - 60% relative humidity. Target design temperatures and relative humidity shall be 70°F - 80°F and 45% - 55% relative humidity.

Offices/Staging Areas: Heated to 69°F and air conditioned to 76°F.

Support Areas, Toilet, Mechanical, and Electrical Rooms: Heated and ventilated to 65°F.

6.11.1.3 Space Ventilation: Minimum total and outside air change rates in air changes per hour shall be computed on a per-occupant basis to meet the requirements of ASHRAE Standard 62.1.

6.11.1.4 Mechanical Equipment Rooms: In general, mechanical equipment rooms shall be designed with ventilating systems which will maintain temperatures within 10 degrees F of summer ambient design temperature. However when these equipment rooms house temperature sensitive electronic components, such as microprocessor based controls, electronic circuit breakers, etc., Contractor shall confirm the ambient requirements of such equipment and provide cooling if necessary.

6.11.1.5 Schedule Adjustment: HVAC equipment and thermostat schedule shall be adjustable. Default settings shall be determined during design phase.

6.11.1.6 Communications Rooms: Provide dedicated HVAC systems for sensitive areas requiring 24/7 control of temperature conditions with separate ductless direct expansion split systems.

6.11.1.7 Refrigerants: Refrigeration equipment shall utilize refrigerant having an Ozone Depletion Potential (ODP) of not greater than 0.05. Refrigeration room design shall include the safety features, such as sensing devices, purge ventilation system, etc., as required for the particular refrigerant in accordance with ASHRAE Standards 15 and 34.

6.11.1.8 Mechanical Equipment Space: Location of air handlers and other equipment is to be in compliance with ATFP, and take account of the typical and any unique climatic and local conditions at the facility



location. Systems are to be located such that equipment and persons maintaining equipment are protected from the elements as far as reasonably possible. Maintenance personnel access to equipment room penthouses, etc. is to be along safe, clearly designated routes without portable ladders or temporary equipment. Air handling units shall be located in equipment rooms when feasible. Roof top mounted equipment is discouraged. It is understood that there may be some rooftop equipment such as vents, hoods, etc. which are unavoidable, but all attempts shall be made to not locate equipment which requires routine maintenance on the roof. Any equipment exterior to the building envelope is to be shielded from sight by appropriate enclosures or surrounds and is to be consistent with the designer's exterior architectural design intent and any other applicable directive included in this RFP.

6.11.1.9 Heating, Ventilating and Air Conditioning (HVAC): HVAC systems shall be intrinsically safe from freezing in the project climate. Consideration shall be given to combustion air arrangement for gas fired equipment to prevent cold drafts. Negative pressurization of any building areas shall be avoided to minimize infiltration.

6.11.1.10 HVAC System Design for Functional Areas: The primary consideration of the HVAC design is to provide the environmental conditions required to meet the functional requirements. Single duct terminal reheat variable air volume systems or a geothermal heat pump system (refer to Option 6) or combinations of such air distribution systems shall be acceptable and meet life cycle cost analysis requirements. If utilized, VAV systems will be of the minimum air quantity type. The HVAC systems shall be capable of providing thermal control zones for individual rooms or groups of similar use. All terminal boxes shall be pressure independent type.

6.11.1.11 Building Heating and Cooling Systems: The arrangement and configuration of mechanical systems described below are from preliminary planning sessions and form the basis of design. D-B Contractor is responsible for final equipment selection and sizing as required to meet UFC design guidelines, the user's requirements and life cycle cost analyses.

6.11.1.11.1 Paint Hangar Cooling Systems: Cooling source shall be an air cooled Chiller, multiple scroll compressor type with at least two independent circuits and shall be equipped with dedicated chilled water circulation pumps. Air cooled chiller will be mounted outside in the mechanical equipment yard. Paint Hangar Bay Humidification System: Packaged steam generator shall be located indoors in Mechanical Room on make-up air unit vestibule. DB Contractor shall provide combustion air, flue vent piping to outdoors, gas piping, make-up water system, drain piping and steam distribution piping between steam generator and steam distribution panel in accordance with humidification system manufacturer recommendations. Provide LCDD analysis for heat recovery chiller, heat exchangers, cooling tower controls and interconnecting piping to provide recovered heat to temper the hot water used for aircraft washing in the existing wash bay in Bid Option 7.

6.11.1.11.2 Building Heating Systems: Two gas fired hot water boilers shall be provided, each sized to provide 65% of the facility heating load. Boilers shall be high efficiency condensing type. Each boiler will have a dedicated circulating pump. A secondary variable speed hot water pump with variable speed drive will circulate hot water to the AHU's, reheat coils, unit heaters, etc. A redundant secondary variable speed pump shall be provided for standby purposes.

6.11.1.11.3 Air Distribution Systems: Air handling units shall be double wall, internally-insulated, readily maintainable. Provide access doors to all internal components so that the entire interior of the air handling unit can be cleaned. Access door shall be a minimum of 18" wide, except where upstream heating coil face access is available through filter housing, or where the downstream cooling coil face access is available through the fan section. Coil face velocities shall not exceed 450 feet per minute. Air handling unit will be equipped with pre-heat

hot water heating coil, DX cooling coil, supply fan and return fan and IAQ type positive sloped drain pans. Cooling coils will have UV sterilization lamps. Air handler will be equipped with outside air intake louvers capable of 100% outside air economizer operation. The unit will be initially sized for approximately 30% outside ventilation/make-up air (to be adjusted with final ventilation calculation based on ASHRAE 62.1 and facility exhaust requirements when not operating in 100% outside air economizer mode. Conditioned and ventilation air will be supplied to VAV terminal boxes in spiral or oval distribution duct unless space requirements limit height to rectangular duct. Minimum air volume of VAV terminal boxes shall be set either by minimum air change criteria or minimum volume necessary to provide the occupant ventilation per ASHRAE 62.1 requirements or exhaust make-up air. Hot water reheat coil at VAV terminal shall be provided to maintain space conditions at temperatures as described above. Return air shall all be ducted back to AHU and return fan. The return duct system shall be a 100% ducted return system. Return plenum ceiling shall not be used.

## PART 1 - GENERAL

### 6.11.1.11.4 PAINT SPRAY BOOTH

#### 6.11.1.11.4.1.1 Related Documents

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections apply to this Section.

#### 6.11.1.11.4.1.2 References

The publication listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 201 - (2002) Fans and Systems

AMCA 210 - (1999) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

AMCA 211 - (1994) Certified Ratings Program - Air Performance

AMCA 300 - (1996) Reverberant Room Method for Sound Testing of Fans

AMCA 301 - (1990) Methods for Calculating Fan Sound Ratings from Laboratory Test Data

AMCA 500D - (1998) Laboratory Methods for Testing Dampers for Rating

AMCA 99 - (1999 r. 2003) Standards Handbook

AMCA 99-0401-66 - (1986) Classification for Spark Resistant Construction

AMCA Licensed Products - (Online) Directory of Products Licensed Under the

AMCA International Certified Ratings Program

### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 - (2000) Industrial Control and Systems: General Requirements

NEMA ICS 2 - (2000) Industrial Controls and Systems: Controllers, Contactors, and Overload Relays Rated Not More than 2000 volts AC or 750 Volts DC

NEMA ICS 6 - (1993) Industrial Control and Systems: Enclosures

NEMA MG 1 - (2003; r2004) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 33 - (2007) Spray Application Using Flammable or Combustible Materials

NFPA 70 - (2008) National Electric Code

NFPA 91 - (2004) Exhaust Systems for Air Conveying of Vapors, Gases, Mists and noncombustible Particulate Solids

SHEET METAL AND AIR CONDITIONING CONTRACTOR'S NATIONAL ASSOCIATION (SMACNA)

SMACNA Industry Practice (1975, 1<sup>st</sup> Ed) Accepted Industry Practice for Industrial Duct Construction

SMACNA Leakage Test Mnl (1985, 1<sup>st</sup> Ed) HVAC Air Duct Leakage Test Manual

SMACNA Rectangle Duct Const (1980, 1<sup>st</sup> Ed) Rectangular Industrial Duct Construction Standards

SMACNA Rnd Duct Const (1999, 2<sup>nd</sup> Ed) Round Industrial Duct Construction Standards

#### 6.11.1.11.4.1.3 SUMMARY

Work Included: Paint Booth Contractor (herein PBC) shall provide complete turnkey product under this contract. PBC is responsible for furnishing and installing a complete spray booth package. Furnish crossdraft laminar flow spray booth of capacity specified. Paint booth shall include air intake plenum, filters and racks, four-stage particulate exhaust filtration, and high-pressure plenum, lighting and PLC controls, make-up air-handling unit, recirculation and exhaust fans. Specific information on the types and quantities of paints used in the composite repair process to comply with Base pollution abatement regulations will be provided at time of contract award.

The package shall include the following items.

Paint Booth Enclosure

Flashing between building walls and door openings of spray booth

Booth Lighting

Make-Up Air Unit

Energy Recovery

Humidification Steam Generator

Exhaust Fan

Recirculation Fans

Apertures for placement of HEF generators

Apertures in booth sidewall for entrance of utilities

Plenum Filter Door with filter racks and filters

PLC controls w/Touch screen Interface

VOC and LEL monitors and alarms

Power Distribution / Control Wiring from Primary Paint Booth Control Panel to auxiliary components (i.e. MUA, Ex. Fans, Lights)

#### 6.11.1.11.4.1.4      INSTALLATION

Installation of Paint Booth enclosure

Mechanical installation of all components listed above

Electrical installation of all components listed above

Start-Up, Commissioning, Air Balancing, Training.

Warranty

Work Specifically Not Included:

Exterior Man Access Doors

Fire Protection for Paint Booth

Concrete work

Exhaust Stack Support Bracing

Compressed Air Lines (Tool and Breathing Air)

Water Supply and Drain Lines

Chilled Water Piping

Natural Gas Piping

Power Supply to Paint Booth

#### 6.11.1.11.4.1.5      QUALITY ASSURANCE

Applicable Standards: Designs and fabricate paint spray booth and exhaust in accordance with applicable standards. Installation shall be in accordance with provisions of National Electrical Code, NFPA 33 and the International Building Code. All items listed in this section as part of the booth system are to be supplied by a single source booth Paint Booth Contractor (PBC).

## 6.11.1.11.4.1.6 PAINT BOOTH CONTRACTOR MINIMUM REQUIREMENTS

PBC to have been in business of manufacturing and installing industrial spray booths for not less than 5 years.

PBC to have completed at least three USAF projects that incorporated spray booths designed specifically for aircraft.

## 6.11.1.11.4.1.7 PERFORMANCE REQUIREMENTS

## A. Airflow Requirements

**“Spray Mode”:** This mode is designed for 100 fpm in the booth to remove overspray. Paint Spray applications parameters are 65-85 degrees F, 40%-60% RH. Target design temperatures and relative humidities shall be 70-80°F and 45% to 55% RH and controlled to within +/- 2 degrees F of the target temperature set point and +/- 2 % of the RH setpoint. Recirculation fans operate at full capacity to provide 80/20 recirculation.

**“Brush/Roll Painting”:** This mode is at a reduced velocity of 50 fpm and is intended to be used when areas of the aircraft are being painted using brushes or roller application means. Target design temperatures and relative humidities shall be 70-80° F and 45% to 55% RH and controlled to within +/- 2 degrees F of the target temperature set point and +/- 2 % of the RH setpoint. This is an 80/20 recirculation mode at reduced airflow conditions.

**“Stand-by Heat”:** This mode uses 100% outside air at a reduced velocity but maintains a 50°F temperature level in the booth while planes are being stored or the area is unused. This is an economy measure to reduce costs while the booth is not being used. The unit runs as needed. The recirculation fans will not operate.

**“Cure/Dry Mode”:** This mode is used after painting and is an ambient (70-80°F) cure for a set period of time. After this mode times out, the system switches immediately to brush/roll mode. Humidity control is not required during this mode. Airflow is reduced in the booth to 50 fpm. This is an 80/20 recirculation mode of operation.

**“Purge Mode”:** This mode is for upsets and will stop the recirculation fans, closing their dampers. The make-up air system will run at full flow and the exhaust fan will run at full flow.

**Spray Booth Pressurization:** Booth to have an “Auto-Balance System”: designed to automatically keep the paint booth balanced during operation. The system shall consist of a variable frequency drives that control the speed of the exhaust ventilation, differential pressure transmitters and sensing probes. The PLC control system shall monitor the interior booth pressure versus the factory and adjust the exhaust system fan speed to maintain constant airflow through the booth as the exhaust filter pressure drop increases.

Include provisions to allow for the future reduction in the amount of make-up air if the occupancy or paints/chemicals used in the space change.

## B. Spray Booth Filtration Systems

Filtration of the Supply air entering the spray booth shall consist of 20"x20"x1" high-diffusion intake filters located in the filter plenum door at the booth front.

PBC shall provide complete balanced airflow across entire width of filter chamber. Components such as perforated plates, balancing dampers and sheet metal baffling to be used in filter chamber to achieve uniform airflow. Velocity profiles across the filter chamber as measured 12" normal to the filter racks shall be relatively uniform throughout the length of the paint spray booth. (i.e. 100 FPM +/- 15%)

## C. Supervisory Control System

The spray booth operations shall cease (air supply shut down to paint guns) upon failure of any exhaust or supply air fan, upon a man door being open, upon a lighting fixture lens being open or upon notification from the building fire alarm panel.

Upon a man door being opened during spraying or curing operations, the PLC system will first sound an alarm after a 60-second delay (adjustable). The alarm would be allowed to sound for 30 seconds and then the air supply to the paint guns would be shut down.

## 6.11.1.11.4.1.8 SUBMITTALS

## A. Manufacturer's Literature: Required data to include, but not necessarily limited to:

Unit designation.

Unit dimensions and weight.

Complete electrical data including wiring diagrams.

Complete description of materials and methods of construction including finishes.

Fan capacities – CFM quantities at specified conditions.

Fan motors including type, horsepower, speed, operating conditions, locked rotor amps, and voltage phase and hertz.

Location and size of electrical connections.

Booth structure and panels showing connections and member sizes. Include mill certificates for ceiling beams.

Make up air-handling units including type, manufacturer and model number, capacity, motor size, operating conditions, voltage, phase and hertz, natural gas requirements and size and weight.

Filter data and NESHAP test data reports

Changes and Substitutions: Any changes to the original design will need to be submitted for permit review by the PBC and shall contain the seal of a Professional Structural, Mechanical or Electrical Engineer.

#### SD-02 Shop Drawings

Industrial ventilation and exhaust systems

Makeup Air Unit drawings

Makeup Air Unit curb drawings

Recirculation fan and drawing

#### SD-03 Product Data

Fans

Make-up Air Unit

Dampers

Flexible Connectors

Sealants

Access Ports

Damper Operators

Vibration Isolators

#### SD-06 Test Reports

Fan Tests, including sound power level test

Ventilation and exhaust system start-up tests

Lighting level tests

Filter Method 319 Test reports

SD-07 Certificates

Welding Procedures

SD-10 Operation and Maintenance Data

Fans, Data Package 2

Filtration manuals

Filter Monitor

LEL Monitor

VOC Monitor

VFD data package

PLC data package

Make-up Air unit Operation and Maintenance Data

Air Solenoid Valve

SD-11 Closeout Submittals

Posted Operating Instructions

Commissioning test report

#### 6.11.1.11.4.1.9 COORDINATION

The PBC shall be responsible for coordinating all paint booth related installations with all other trades to avoid any conflicts with piping, ductwork, structure, electrical devices, etc.

PBC shall provide ductwork rough opening sizes to Design-Build (DB) Contractor.

#### 6.11.1.11.4.1.10 WARRANTY

Include 1-year warranty on parts and labor for entire spray booth assembly.

### **PART 2 – PRODUCTS**

#### 6.11.1.11.4.2.1 PAINT SPRAY BOOTH

##### A. Spray Booth Construction

Booths to be constructed of 18 gauge galvanized sheet steel pre-coated white, complete with protective coating that is removed after installation.

18 gauge panels to be complete with breaks for added strength and personnel safety.

Booth panels are to be custom engineered for this project. Openings for all booth related equipment (i.e. lights, man doors, etc.) are to be designed into the panels before manufacturing.

Sidewall utility "niches" shall be provided for entry of utilities.

## B. Structure

Each Structural Column to be equipped with floor baseplate to be welded to embedded plate furnished and installed by GC.

Booth ceiling to be suspended by rods and turnbuckles from the building structural steel. Clips shall be added to structural steel by the GC to allow attachment of the rods and turnbuckles.

Booth intake plenum door to be furnished and installed by the PBC. Intake filter racks and filters shall be provided and installed by the PBC.

Sections of spray booths to be sealed with latex-based caulk or sealant. Silicon-based sealants or caulks are not permitted. Caulk all panel joints and all joints with the concrete floor. Take special care in the caulking of the exhaust chamber since it is under high negative pressure.

Structural Steel: All W-shapes to be from ASTM A992 steel. HSS square tube to be ASTM A500 Grade B. All other steel to be ASTM A36.

## C. Paint Hangar Bay Exterior Plenum Door

Paint Hangar exterior plenum doors shall be electro-hydraulically operated swinging plenum type steel framed doors of the same manufacture as the paint booth.

1. Doors shall operate without binding or damage to weather stripping. Doors shall have minimum air leakage and be free from warpage. Door size shall be as shown in the drawings.
2. Door filter bank support framing shall fully accommodate filter banks provided by paint booth manufacturer.
3. Exterior metal insulated panels shall be the same panels used in the hangar construction.
4. The hangar door shall consist of double leaf plenum doors designed to accommodate the laminar flow supply air ventilation requirements for the paint booth operations. Plenum door leaves shall be supported by heavy duty pivot hinges and stabilized by hard rubber wheels. Door will be driven by an electric motor driven hydraulic pump and hydraulic ram mechanism. Doors shall be designed to operate at a maximum speed of door movement at the periphery of 30 feet per minute. Each door leaf shall provide an air plenum assembly as required by the paint booth manufacturer's filter banks, and shall be fitted with seals to provide air seals to the building and paint booth air supply ductwork.
5. Doors shall operate at sustained winds up to 40 miles per hour.
6. The tubular steel structural framing system, for each plenum door leaf, shall consist of a Vierendeel Truss Space Frame. The structural framing shall accommodate filter banks as designed and provided by the paint booth manufacturer.
7. Provide sealing system between door leaves and building framing, between door leaf and hangar floor slab and between door leaves. Provide an air seal between door and building at the ventilation supply plenum ductwork, per requirements of the paint booth manufacturer. Coordinate the design of the door seal system with the building architectural and structural details and the mechanical ventilation systems. Use fully adjustable door seal system to permit initial setting during installation of the doors and to permit future adjustments. Use door sealing system designed for ease of replacement and that incorporates commercially available components.
8. Provide electrical wiring and equipment so located on the door to comply with Class 1, Division 1 locations as described in article 501 of NFPA-70. An electrically operated hydraulic pump and hydraulic cylinder shall be the prime mover for each door leaf.
9. Warranty: minimum one year after Beneficial Occupancy Date (BOD) for the hangar doors, top guides, and electrical system against all defects in material and workmanship.
10. Provide operations and maintenance training and reference materials.

## 6.11.1.11.4.2.2 LIGHTING

Furnish and install 4 ft, 4-tube, T5 light fixtures at locations as noted on plans. Light fixtures must be designed specifically for paint booth applications and be serviced from inside the paint booth.



One fixture at each paint booth exit to dedicated for exit lights of the paint booth. These fixtures are to have continuous power and to be complete with battery back-up ballasts to allow the illumination of (2) of the lamps within the fixture during power outage. An "EXIT" sticker with size conforming to the 2003 IBC shall be attached to the lens of each fixture.

Fixture: Inside access fluorescent fixtures with hinged door panel with a seal to guard against vapor, dust and moisture. Lights to be rated as Class I, Division 2, Groups A, B, C, D. Fixtures are to be ETL & ETL-C listed and are listed for locations having deposits or readily combustible paint residue. Provide temporary light clips to hold light in place so that only one person is required to install light fixture. Fixture must be complete with interlock switch to be wired to PLC system in order to disable spraying operations when front access door is opened. Install light fixtures in sides of booth. Fixture to be four lamp, four-foot fixture complete with lamp tubes.

Lamps: High output T-5 tubes.

Wiring: P.B. Contractor is responsible for all wiring related to light fixtures.

#### 6.11.1.11.4.2.3 FILTRATION SYSTEM

Exhaust First Stage - CPA Media Multi-layered polyester media. The air-entry side shall be constructed of a mixture of lofted denier fiber. The air-leaving side shall be comprised of a mixture of heavily needled media to densify and jet-ink printed for identification and proper installation. The media weight shall be 1.2 ounces per square foot.

Provide two extra sets of exhaust first stage filters

Exhaust Second Stage - The second stage panel shall be constructed of two different layers of tackified polyester media, sealed together so the tackified layers of each media touch in the center. This method of joining the media is with an RF "heat sealer." In addition to the perimeter seal, the product shall have additional sealing in the face in order to keep the two layers connected. The perimeter seals may be sewn, and the center seals on the filter face shall be heat-sealed. The air-entry layer shall be constructed of a multi-layered, multi-density polyester with a heavy, non-migrating tackifier on the air-leaving side. The air-leaving media shall be a heavily-needled polyester, densified to ¼" thick, tackified on the air-entry side with a weight of 0.42 ounces per square foot. The air-leaving side shall be jet-ink printed for identification and proper installation. The filter panel shall have an initial pressure drop of 0.06" water gauge (w.g.) at 150 feet per minute velocity.

Exhaust Third Stage - 6-Pocket Bag Filter: The 6-pocket bag filter shall be constructed of a composite of pre-filter, melt blown and spun bound polyester fibers. The pockets shall be sewn together on the perimeter with tow heat seals, forming three air channels in each bag pocket. Sewn lines to form channel lines are not allowed. Six pockets shall be sewn together, and then sewn onto a nine-gauge metal frame. The metal frame has five crosswires to support the bag pockets. The bag shall be sewn onto a metal frame with no crosswires, with a metal frame with crosswires shall be used to support the pockets in the headers final assembly. The bag pockets on the metal support shall be inserted into a galvanized metal header. The galvanized header shall contain an acceptable sealing agent inside of each header to eliminate the possibility of paint bypass within the filter, "Acceptable" is defined as containing no silicon or other agents, which might damage the painted surface or the painting process. The galvanized header shall have a ¼" foam gasket on the air-leaving side to prevent any paint bypass around the filter assembly.

Exhaust Fourth Stage- Carbon Filtration: Carbon cells shall be 24" x 24" x 3" with 25 lb/cf in bulk density and rated for velocity of 120 fpm through the cell to capture 90% of the hydrocarbons in the airstream.

Intake Filters for Plenum Door: The filter system supplied and installed by the PBC shall consist of a replaceable media filter system in a permanent frame filter bank mounted in the door frame. The filter frame bank shall consist of universal modular frames, nominal 24 inches by 24 inches by 2 inches, fastened to each other to form an assembly. Fabricate frames from 16 gage galvanized steel and include filter holding clips to permit easy removal of the filters without removal of the clips. Provide replaceable filters of the extended surface type, nominal 0.6m by 0.6 m by 51mm deep, with a 30 percent efficiency when rated by [ASHRAE 52.1](#). Filters shall meet the fire-resistant requirements of [UL 900](#), Class 1. Provide pleated type filters with a welded wire media support grid and nonflammable enclosing frame bonded to the filter media.

6.11.1.11.4.2.4 Personnel Doors: All personnel doors are to be provided by the DB Contractor. PBC to provide flashing between personnel doors and paint booth opening. All flashing shall be white in color to match all spray booth components.

#### 6.11.1.11.4.2.5 Ductwork and Ductwork Insulation

Ductwork shall be designed by the PBC.

MAU supply duct shall be capable of withstanding 2.0" W.C. positive static pressure. Duct cross-sectional area shall be sized for a maximum velocity of 2,200 FPM.

All ductwork between MAU and paint booth shall be internally insulated with a minimum of 1" thick, 1.5 PCF density, with an insulating property equaling an R value 4.0 or greater. Duct insulation shall be installed per manufactures recommendations.

Coordinate with other trades the required rough opening size for ductwork through building walls and roof. The DB Contractor shall provide openings and flash ductwork to building surface.

Exhaust Ductwork shall be 48" DIA spiral comprised of 20 GA. Galvanized Material. The DB Contractor shall provide (2) lateral support braces from building to each exhaust stack.

Provide gravity, type roof ventilator at each exhaust stack that will prevent rain and snow from entering exhaust stack when not in use.

Provide purge dampers with electric operators in each of the recirculation ducts.

#### 6.11.1.1.4.2.6 RECIRCULATION SYSTEM

Basis of design shall be Mixed Flow Fans.

Housing: Continuously welded steel housing to assure no air leakage. Housing shall have inlet and outlet collars for slip fit duct connections. The housing and bearing support shall be constructed of structural steel members to prevent vibration and rigidly support the shaft and bearings. Welded steel vanes shall straighten the flow of air from the fan discharge and support bearings and drives. Motor supports shall be heavy gauge steel and are welded to the fan housing. Motor plates with jackscrews shall provide belt-tensioning adjustment. Turned, precision ground and polished steel shafts shall be sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class. Close tolerances shall be maintained where the shaft makes contact with the bearing.

Bearings shall be heavy duty, grease lubricated, self-aligning ball or roller flange mounted bearings with extended lubrication lines. Bearings shall be selected for a minimum life (L-10) of 80,000 hours at maximum operating speed and horsepower for each construction level. The fan shall be equipped with extended lube lines with grease fittings allowing lubrication without disassembling the fan. Provide belt guards for protection from rotating drive components (OSHA Requirement). All sound levels shall be calculated per AMCA publication 201.

Fan motors: TEFC high efficiency, 460/3/60, inverter duty rated. Sound requirements: Noise levels produced by exhaust system components shall not exceed 80 dBA @ 5 feet from operating equipment

#### 6.11.1.11.4.2.7 DIRECT FIRED GAS HEATING AND VENTILATION UNITS

##### A. GENERAL

Basis of design: Direct-Fired Gas Heating and Ventilating Unit. Orientation shall be horizontal.

Unit(s) shall be factory assembled, tested and shipped as a complete packaged assembly, for outdoor mounting, consisting of the following:

- gas burner
- centrifugal blower (backward curved plenum type)
- variable frequency drive with thermal overload protection
- motor and drive assembly
- fuel burning and safety equipment
- temperature control system
- gas piping
- automatic modulating burner profile damper

6.11.1.11.4.2.8 Make-up air unit to be provided with energy recovery capabilities.

6.11.1.11.4.2.9 Steam humidification system shall be provided to add steam to the incoming outside air stream based on maintaining required humidity levels with the booth.

- Stainless steel grid style steam distribution shall be installed in the air make-up unit. Design shall utilize multiple horizontal tubes with top steam openings.

- Thermostatic steam traps (2) shall be mounted and dipped within the unit.

6.11.1.11.4.2.10 Gas fired steam generator(s) shall be provided. Unit shall be indirect fired with stainless steel evaporation chambers.

- Unit shall be provided with three (3) power burners. Two (2) burners shall have on/off control with one (1) burner fuel modulation. Burners shall be provided with Fm fuel trains and main gas pressure regulators.
- Water level shall be controlled by a tri-probe level control for controlling fill valve operation and shall provide for a low level alarm. Fill valve shall be solenoid type with needle valve provided for final adjustment.
- Unit shall be provided with automatic drain/back flush cycle controlled by PLC based on run time hours. System shall include drain solenoid valve, manual drain valve over-ride, and drain water tempering heat exchanger to limit drain water temperature to  $\leq 140^{\circ}$  F.
- Burner exhaust flues shall be connected to a common 8" double wall, stainless steel exhaust flue. Flue shall be B-vent rated and shall be provided with drain tee, wall penetration assembly, and weather cap.

#### B. APPROVALS

Unit shall be tested in accordance with ANSI Standard Z83.4 and Z83.18, and shall bear the ETL label. All electrical enclosures and remote panels on standard units shall be UL 508 listed.

Gas Train shall be "FM Approved"

#### C. CASING

Unit casing shall be constructed of 18 Gauge G-90 galvanized steel. The wall panels and roof panels shall be fabricated by forming double-standing, self-locking seams that require no additional support. The floor shall be constructed of 16 Gauge G-90 galvanized steel. The base and floor support channels shall be constructed of 12 Gauge G-90 galvanized steel. The floor and wall panels shall be caulked air tight with a latex caulk. All casing panels shall be attached with sheet-metal, screws, which can be removed to field service large components. The unit base shall be suitable for curb or flat mount. Casing Construction should be suitable for Outdoor or Indoor Installation.

An observation port shall be located on the exterior of the unit for observation of the main flame and Pilot flame. All controls, gas valves, modulating controls and electrical components shall be mounted within the, burner Vestibule. The burner Vestibule shall be an integral part of the unit and not extend outside the exterior casing of the unit. It shall be complete with hinged-access doors and not exposed to the main air stream.

The vestibule full-size, hinged-gasket access doors shall have a minimum of two (2) latches. Vestibule doors shall require tooled access and easy access to controls and gas-train components. Blower door shall provide easy access to blower, motor and drives and also include a minimum of two (2) latches. All doors shall include 20 Gauge G-90 galvanized steel liners for added rigidity and positive seal. All Access doors shall have a continuous aluminum hinge with stainless steel pin. Latches shall be a heavy duty Lift and Turn type Latch that is flush to the casing surface. Latches shall have a sealing gasket to prevent water leakage.

Balancing dampers shall be installed in the burner profile to maintain a constant velocity across the burner.

#### D. FINISH: White enamel

#### E. BLOWER AND DRIVES

Blower shall be backward-curved, Class I, double width, plenum fan, with pillow-block grease bearings, with a minimum life expectancy of 100,000 hours. Unit shall have a heavy-duty, solid-steel shaft. Blower drives shall be of the fixed type. All drives shall be a minimum of 2 groove above 3 HP.

Blower assemblies shall be mounted on unitary spring isolated base with a minimum of four (4) spring isolators

All blowers shall be tested and set at rated speed after being installed in the factory-assembled unit.

#### F. MOTOR

Blower motors shall be suitable for operation on 440-480 volts, 60 cycle, 3 phase, 4-wire power. Blower Motors shall be a Open Drip Proof, High Efficiency EPACT, inverter duty, with a minimum 1.15 service factor. Blower motors shall have an adjustable mount, made of heavy gauge steel.

#### G. BURNER

The gas burner shall be a direct-fired, draw-through type, using natural gas at an inlet-supply pressure to the unit of 29 inches to 5 pounds per square inch (PSI).

The burner shall be capable of heating the entire air supply a temperature rise of 90 degrees Fahrenheit. The burner shall burn over its entire length at all times when the system is in operation.

The burner shall have non-clogging, 4302B stainless-steel combustion baffles attached to a ductile cast-iron gas-supply section with no moving parts to wear out or fail. The burner shall be capable of 100% combustion efficiency with a maximum turndown ratio of 30 to 1.

The gas burner shall be furnished with a pilot package arranged so that the pilot flame lights the burner with instantaneous ignition. Pilot assembly shall include a flame rod, spark rod and pilot automatically ignited by a 6,000 volt ignition transformer. A Honeywell 7800 flame-rod rectification system with test lights shall be used to prove pilot and main flame.

A pilot-access panel shall be provided in the unit casing.

#### H. GAS EQUIPMENT

All gas equipment shall conform to local-Code requirements. All gas manifold components shall be piped, wired and tested at the factory. Gas manifold shall be FM approved.

#### I. SAFETY CONTROLS: Components include:

- variable frequency drive with adjustable overloads
- air flow safety switch
- electronic flame safety relay
- high temperature limit switch
- starter interlock
- control system fuse
- flame failure unit shutdown
- outdoor safety switch (disconnect)

#### J. TEMPERATURE CONTROL SYSTEM

Factory Supplied Signal conditioner shall accept a 4-20mA or 0-10 VDC signal from the PLC control for the purpose of modulating the output of the burner. The PLC control system with touch screen shall maintain blower and burner operation and monitor critical components of the MUA. MUA unit manufacturer shall provide terminal block connections for all status and operational I/O as described in the attached PLC schedule.

#### K. ACCESSORIES

External Inlet Dampers: Manufacturer shall provide and install on unit, when possible, a two-position, motor-operated damper with internal end switch to energize the blower-starter circuit, when damper is 80% open. Blades shall be a maximum of 6 inch wide 16 Gauge G-90 galvanized steel shall be made to guarantee the absence of noticeable vibration at design air velocities. Damper blades shall be mounted on friction-free synthetic bearings. Damper edges shall have PVC coated polyester fabric mechanically locked into blade edge. Jamb seals shall be flexible metal, compression type. Down discharge units shall have Internal Discharge damper and motor mounted in unit.

Two inch Disposable Filters: The filters shall be 2-inch thick, pleated fiberglass, 30% efficient. Filter Section: The filter section shall be uninsulated, constructed of G-90 galvanized steel with filters supported by internal slides and with removable access panels. Filters shall be provided in a v-bank arrangement.

12" Rigid 65% cartridge filter with metal frame and filter holding clips.

## L. VARIABLE AIR VOLUME

Variable Air Volume shall be accomplished by Variable Frequency Drives Provided and Installed by the PBC. The Variable Frequency Drive will be located within the vestibule. Unit shall be capable of motor turndown of 40%, while fast acting automatic damper maintains proper air velocity across the burner. Unit shall include control interface to prevent overfiring at lower speeds.

## M. WIRING AND ELECTRICAL

The control circuit voltage shall be 115 volts. A control transformer shall be provided by the PBC for all 115V paint booth control circuits. The control wiring shall be carried in wire channel or conduit. Wiring in control enclosures shall be in accordance with the National Electrical Code.

Unit shall be complete remote PLC control rack with all unit I/O mounted and wired, switches, safety controls, conduit and wire as previously mentioned, and as required for proper operation. Provide factory wired terminal block for connection to the PLC control system. Provide PLC control schedule for list of I/O related to the MUA's. All factory-mounted controls shall be factory prewired to the unit control panel.

## N. ENCLOSURES AND WEATHERPROOFING

Externally mounted PLC I/O racks shall be manufactured specifically for the installation. Electrical components and wiring shall be appropriately selected for use in the environment in which it is installed. Provide, ventilation, heating units in enclosures as required. The unit construction shall be a standard weatherproof design.

## O. FACTORY TESTED

Unit shall be operated, tested and set at the factory using job-site conditions for electrical and gas input. All operating and safety controls shall be tested and set at the factory. The sheaves shall be selected and tested for the proper RPM at specified conditions. Gas-pressure regulator shall be set for specified burning rate at specified inlet pressure.

## P. SERVICE AND PARTS

The PBC shall furnish gas piping schematics, as built wiring connection and control-circuit diagrams, dimension sheets and a full description of the unit. Service manuals, showing service and maintenance requirements, shall be provided with each unit.

## 6.11.1.11.4.2.9 PAINT BOOTH CONTROLS

Control Panels: Each paint booth shall be equipped with a control panel to control paint booth functions and to allow an operator interface.

Control Panel shall be NEMA-12 rated. Paint spray booth shall have a control panel of adequate size to house main PLC, door mounted touch-screen and Magnehelic transmitters, control transformer, VFD'S w/line reactors, surge-protected power supply, fuses and misc. terminal blocks and relays.

UL industrial listing required.

VOC Detection: Each paint booth shall be equipped with two VOC detection devices, each device to detect a different chemical composition.

LEL Detection

Emergency Shut-Down

- PBC shall provide (2) 3/4" Dia. Air Solenoid valves. ((1) air solenoid for each side of booth). Contract shall install solenoid valve upstream of paint booth paint supply air connections. PBC shall wire solenoid valve to PLC control system.
- Solenoid valves shall disengage paint spray supply air when supply air fan or exhaust fans are off, any paint booth door is opened, when any light access lens is opened or upon a signal from the building fire alarm panel as required by NFPA-33.
- Man Door Delay: Upon a man door being opened during spraying or curing operations, the PLC system shall first sound an alarm after a 60 second delay (adjustable). The alarm shall to sound for 30 seconds and then the air supply to the paint guns shall be shut down.

## 6.11.1.11.4.2.10 PLC CONTROL SYSTEMS

## A. General Specifications

This specification has been developed to establish minimum requirements for a solid-state programmable controller designed to provide high reliability in industrial applications. The internal wiring of the controller shall be fixed, with the logic functions it must perform in a given application to be programmed into its memory. The controller shall be supplied with the CPU, input/output scanner, inputs, outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable programmable controller system.

The objective of the programmable controller will be to improve reliability, maintainability, and efficiency by reducing operating costs and downtime.

6.11.1.11.4.2.11      Service: The PBC shall provide operating instruction manuals with adequate information pertaining to the following:

- System specifications
- Electrical power requirements
- Application considerations
- Assembly and installation procedures
- Power up procedures
- Troubleshooting procedures
- Programming procedures
- Explanation of internal fault diagnostics
- Shut down procedures
- Recommended spare parts list

6.11.1.11.4.2.12      On-Site Training: The PBC shall have the capability to conduct on-site training programs at a location provided by the owner.

6.11.1.11.4.2.13      Assembled Control Systems

The PBC shall assume single source responsibility for control system assembly. An assembled system may include mounting and wiring of relays, motor starters, transformers, and disconnecting means, or other control devices as specified by owner-supplied documentation.

The PBC Contractor shall provide mounting and wiring of the programmable controller system in a NEMA type 12 enclosure. (Assumes Control Panel Location in Body Bay).

The P.B. Contractor shall wire all programmable controller inputs and outputs as listed in the PLC I/O schedule.

All pushbuttons, switches and other operator devices must be UL listed and/or CSA approved, and sufficiently large and durable to provide dependable, long life operation.

All cables (with associated plugs, connectors and receptacles) requiring user field installation, shall be designed for commercial use to withstand an industrial environment.

The PBC shall submit drawings of the complete assembled system for approval by Cordova Design.

Drawings that are returned to the PBC for correction or revision shall be resubmitted for approval before starting fabrication of the work in question unless marked "approved as noted".

All drawings shall include page, sheet, and line numbers.

The PBC shall provide documentation detailing the mounting of the processor, I/O racks, motor starters, disconnect switch, fuse blocks, wireways, etc. All materials shall be labeled to provide easy cross-reference to the Bill of Material listing.

Electrical prints detailing all hardwiring, done by the PBC to devices such as relays, motor starters, disconnect switches, fuse blocks, etc. shall be provided with individual wire numbers and relay contact cross-reference designations.

Sections describing inputs shall designate input modules by name, slot, module, and terminal location.

6.11.1.11.4.2.14           BOOTH PRESSURE CONTROL SYSTEM

The booth differential pressure will be continuously monitored by the PLC control system with respect to the hangar and maintained at a setpoint that is end-user definable. (-0.04" w.c. to 0.0"w.c.) The system shall be designed so that regardless of the individual loading of the exhaust filter system, the booth will maintain the pressure specified by the end user. Booth pressure to be controlled by varying the percent output signal to the exhaust fan VFD's.

6.11.1.11.4.2.15           EXHAUST FILTER MONITORING

The paint arressance (loading) of the filters is monitored with 2 magnehelic gauges with transmitters. These filter monitor stations allow the operator to gauge the loading of the filter wall in two locations. This will allow for economical management of the replacement of filters.

**PART 3 - EXECUTION**

6.11.1.11.4.3.1           INSTALLATION

PBC is responsible for paint booth installation system, testing and start-up of the assembled Paint Booth.

6.11.1.11.4.3.2           TESTING AND BALANCING

The DB Contractor shall retain a NEEB Certified Testing and Balancing Contractor to conduct airflow velocity and uniformity tests following the procedures defined in Chapter 5 – airflow Test Procedures of the NEBB 3rd Edition – 2009 Procedure Standards for Certified Testing of (laminar flow) Cleanrooms.

6.11.1.11.4.3.3           COMMISSIONING

PBC to provide to (3) sets of project closeout documents to the Architect

Closeout documents to include:

- As-Built Paint Booth Drawings
- O&M Manuals for Paint Booth and Paint Booth Components
- Final Written Sequence of Operation for PLC control system
- A copy of the working PLC program for each booth on CD
- Start-Up report for all Exhaust Fans and Make-Up Air units (Utilizing Mfg. Start-Up Forms)
- Warranty Certificate to Owner (1 Year Parts and Labor)
- P.B. Contractor Emergency Contact Phone Numbers

Manufacturer's representative shall provide a minimum of one days training on paint booth operation, controls and maintenance.

End of Section

## 6.11.2 General Design Considerations:

6.11.2.1 Contaminant Removal: HVAC systems shall be designed to remove or reduce to acceptable levels of volatile chemical and airborne microbiological contaminants within the facility. Systems shall be designed to remove excessive moisture in facility spaces and to control moisture and dust accumulation in air handling units and distribution systems to avoid conditions permitting the growth of pathogenic, allergenic, or otherwise objectionable microorganisms, and to maintain ventilation requirements in conformance with ASHRAE Standards and Guidelines.

6.11.2.4 Balancing Ports and Features: Necessary controls, instrumentation, and balancing ports and devices shall be provided to establish and maintain the required space temperature, and air changes rate, and to facilitate balancing procedures for all systems.

6.11.2.5 Provide thermometers in all outside air, supply air, return air, and mixed air ductwork or fan section and a Dwyer type differential pressure air filter gauge be provided at each filter bank for the air handling unit.

6.11.2.6 All electric motors one HP and larger shall be premium efficiency type. AFF Variable Frequency drives shall be provided for chilled water and hot water distribution systems. Variable frequency drives shall be provided with a bypass switch, a manual starter and automatic restart feature.

## 6.11.3 Cooling and Heating Load Calculations:

6.11.3.1 Heating Load Calculation: Calculations used for determination of primary and airside (including reheat) heating equipment should not include credit for internal load sources, including lighting, people, and equipment. These loads are typically not present, or are much reduced, at night and on weekends. Heat calculations should also take into consideration an additional 15% capacity to accommodate morning warm up loads when night setback temperatures are utilized.

6.11.3.2 Equipment Heat Generation: In many spaces within facilities, a primary component of cooling loads may be equipment heat generation. It is therefore necessary for accurate load determination that the HVAC Contractor coordinate on a project-by-project basis with the equipment supplier, and with the individual Using Agencies, to identify all individual equipment items and the corresponding load contributions. In performing load calculations, the Contractor shall consider the as-designed equipment provisions of each unique space.

6.11.3.3 Do not oversize HVAC equipment responsible for de-humidification. Undersize 5% from peak load.

6.11.3.4 Lighting Loads: Lighting load may present a significant component of the facility cooling loads and as such require consideration of the as-designed lighting fixture numbers and characteristics of each space.

6.11.3.5 Envelope Components: Minimum insulation values for building envelope components are listed in ASHRAE Energy Standard 90.1. U-value calculations shall take into consideration the "fin effect" of metallic elements of wall and roof construction, as for example the effect of steel studs in walls.

## 6.11.4 HVAC Piping Systems:



6.11.4.2 Aboveground Piping: Steel or copper. Steel shall utilize screwed or welded fittings 2" and smaller; welded fittings for 2 ½" and larger. Copper shall utilize solder fittings. Press-fit type technology joining systems are acceptable. DB Contractor shall provide the facility with a spare crimping tool at completion of project, if this technology is used.

6.11.4.3 Pipe Routing: Piping distribution systems should be routed above the corridors whenever practicable, to minimize leaks, maintenance intrusion, and noise in occupied areas of the facility. Pipes shall not be routed through communications rooms or electrical rooms.

6.11.4.4 Identification: Pipe identification shall be by color banding and service labels. Valve identification shall be by brass tags. Lettering size, band width and brass tag size shall follow industry standards:

6.11.4.5 Utility Metering: All utilities on this project shall be provided with a meter and electronic interface units compatible with the facility DDC system.

6.11.4.6 Water Treatment: A chemical pot feeder shall be supplied for each closed water distribution system. Chemical treatment shall provide for removal of oil, grease and permit flushing of wall scale, foreign matter and contaminants from the water system. Final chemical treatment shall provide for scale and corrosion inhibitors and pH control in the range of 8.0 to 10.0 for a period of one year.

6.11.4.7 Leakage Testing: Provide leakage testing on all piping systems using methods and pressure levels established by industry codes and practices.

6.11.4.8 Miscellaneous Piping Hookups including cooling coils, heating coils, terminal heating coils, unit heaters, gas fired humidifiers, boilers, chillers and pumps: Provide all necessary components following industry standard arrangements including but not necessarily limited to the following: air bleed fittings, isolation valves, balance valves, unions or flanges, thermometers, pressure gauges, flow measuring devices, drainage connections, p.t. plugs, strainers, control valves, automatic air removal, expansion tanks, etc.

#### 6.11.5 Air Handling and Distribution:

6.11.5.2 System Shutdown Capability: HVAC systems shall be designed to permit shutdown (night setback/setup, outside air shutdown) of individual areas not in operation on a 24-hour basis. Exhaust of locker rooms/showers, toilets and other normally-exhausted spaces shall be continued without interruption when building is operated on a 24 hour/7 day schedule but configured to be shutdown if the occupancy schedule changes in the future.

6.11.5.3 Outdoor Air Intakes: Outdoor air intakes shall be located as far as practical, but not less than 30 ft, from exhaust outlets of ventilation systems, combustion equipment outlets and plumbing vent stacks, or from areas which may collect vehicular exhaust and other noxious fumes. Locate the bottom of air intakes serving air handling systems as high as practical but not less than 10 ft above ground level, or if installed above the roof, at least 3 ft above roof level. Outdoor air shall not be drawn from equipment rooms.

6.11.5.4 Balancing Provisions: Duct branches serving each individual space shall be provided with a manual balancing damper, accessible above the ceiling, located as remote from the space supply or return fixture as practicable. Balancing dampers shall be provided at each register or diffuser when there is more than one air distribution device served by a branch duct. The balancing damper provided as part of air diffusers is not to be used for system balancing.

6.11.6 Duct Design: Duct systems shall be designed in accordance with applicable criteria. Maximum velocity in ductwork mains shall not exceed 2000 fpm, and velocities in branch ducts and takeoffs shall not exceed recommended levels in these standards. Access panels shall be provided as necessary for access to fire dampers, and control equipment, and to facilitate periodic cleaning or disinfecting of ductwork. All supply air, with the exception of air transferred between spaces for the purpose of pressurization, shall be provided in sheet metal ductwork. Refer to section 6.13 for mechanical system noise design criteria such as duct borne noise; air generated noise and cross talk between spaces.

6.11.6.1 Duct Materials: All ductwork shall be constructed from materials as follows:

- a) Supply, return and exhaust mains: galvanized sheet ASTM A525 coating G90.
- b) Supply & Return run-outs within 5' of grille, register, or diffuser: polymer lined flexible ductwork.
- c) Corrosive exhaust, including wet and chemical corrosive elements: Stainless Steel.

6.11.6.2 Duct Construction: Ductwork constructed to meet SMACNA Third Edition HVAC Ductwork Construction Standards is the minimum acceptable quality. Where specific requirements for ductwork are stated, these requirements will take precedence over SMACNA Standards.

6.11.6.3 Ductwork Pressure Classifications: The minimum pressure classifications and maximum airflow velocities for ductwork system shall be as follows:

Supply ducts between fan and VAV terminals 4" wg 2000 fpm

Supply ducts downstream from VAV terminals 2" wg 800 fpm

Return ducts 2" wg 1800 fpm

Exhaust ducts 2" wg 1200 fpm

6.11.6.3.1 The Contractor shall determine duct section where a higher pressure classification is required.

6.11.6.4 Leakage Criteria and Test Pressures: Air leakage and pressure testing of ductwork distribution systems shall be performed by an independent Test and Balance Agency. All ductwork distribution systems except low pressure downstream from terminal boxes shall be tested. No additional leakage shall be made to the test allowable leakage factor for access doors, fire dampers, sound attenuators etc. that are part of the system under test. Leakage test pressure and allowable leakage in cfm/square foot of duct surface area under test shall not exceed the following:

Test Pressure Maximum Leakage

Supply ducts 4" wg 0.03 cfm/square foot

Return ducts 2" wg 0.04 cfm/square foot

Exhaust ducts 2" wg 0.04 cfm/square foot

6.11.6.4.1 Ductwork under test that exceeds the leakage allowance shall be re-sealed and re-tested.

6.11.6.4.2 All ductwork pressure classifications shall meet SMACNA Seal Class A. Seal all transverse joints, longitudinal seams and duct wall penetrations.

6.11.6.5 Return Air Plenums: The return duct system shall be a 100% ducted return system. Return plenum ceiling shall not be used.

6.11.6.5.1 All exhausted air shall be fully ducted from room to exterior. Outside air and return air in mechanical rooms shall be ducted. Use of the mechanical room as a plenum is not acceptable.

6.11.6.6 Duct Cleanliness: Duct cleanliness shall be not less than Level B Intermediate Level as defined by SMACNA Duct cleanliness for New Construction Guidelines.

6.11.6.7 Duct Lining: Duct lining shall not be used. Sound attenuators, packed type, which comply with ASTM C1071 and UL 181, shall be used in lieu of duct lining to attenuate fan noise where required.

6.11.6.8 Flexible Duct: Flexible duct shall be insulated type with inner and outer covering. Flexible duct to VAV boxes shall not exceed five (5) duct diameters in extended length. Flexible ducts shall not be used to connect between sheet metal ducts.

6.11.7 Maintenance Provisions:

6.11.7.1 General Personnel Access: Safe and practical means of personnel access must be provided to, and within, all areas of the facility where equipment is located, to adequately provide for operation, maintenance, and replacement (O&M) of the equipment. Access to equipment rooms from outside the facility shall be provided within equipment rooms, a minimum of thirty inches of clearance is required at all service points to mechanical equipment. The design of O&M personnel access ways should not provide less than 5.5 ft of overhead clearance (except on intermittent basis), or require personnel to climb over equipment or crawl on hands and knees. Locate systems such that equipment and persons maintaining the equipment are protected from the elements as far as reasonably possible. Maintenance personnel access to equipment rooms and mechanical equipment is to be along safe, clearly designated routes without portable ladders or temporary equipment. Locate AHU's in equipment rooms or within conditioned enclosures providing protection from the weather and safe, efficient access. Any equipment exterior to building envelope shall be shielded from sight by appropriate enclosures or surrounds, and to be consistent with designer's exterior architectural design intent and any other applicable directive included in the RFP. Mechanical room location and layout shall consider: coordination with other trade/code/manufacture clearances around and above equipment; sufficiency of space and access to equipment; and optimization of distribution runs.

6.11.7.2 Equipment Clearances: Minimum clearances between electrical and mechanical equipment shall be as required by NFPA 70. Assure that practical means are provided for the removal/replacement of the largest and/or heaviest equipment item(s) located in the facility. Provide adequate pull space for all coils, heat exchangers, chillers and filters. Sufficient space shall be provided in above-ceiling areas to facilitate equipment installation and O&M.

6.11.7.3 Suspended/Mounted Mechanical Equipment: Where suspended and mounted equipment is installed, provide a minimum of 72 inches clearance above access pathways for headroom as required. For any work location requiring maintenance access, provide a fixed ladder and/or catwalk.

6.11.7.4 Air Distribution System Components: Outdoor air intake plenums, air handling unit casings and distribution ductwork shall be designed to permit access for periodic cleaning.

6.11.7.5 HVAC System Balancing Provisions: Adequate access shall be provided to facilitate operation, adjustment, and testing at all HVAC balancing and measuring points and equipment, including automatic and manual damper operators, air terminal units, pilot tube ports, valves, and sensing devices.

6.11.8 Interdisciplinary Coordination:

6.11.8.1 Smoke and Fire Dampers: HVAC service zones should be designed to coincide with smoke and fire zones whenever practicable. Ductwork penetrations of fire/smoke rated walls should be minimized, to minimize the required number of smoke/fire dampers and complexity of controls. Coordinate with the architectural design to assure that necessary access for inspection or service of these dampers is provided.

6.11.8.2 Smoke Mode Operation: Air handling and distribution systems shall react to the detection of smoke in accordance with NFPA 101 and 90A. Where required by NFPA 101, NFPA 99, or ANSI A17.1, smoke evacuation or venting features shall be provided.

6.11.8.3 Testing of HVAC systems under fire alarm conditions, to permit verification of correct function shall be provided.

6.11.9 Ventilation Design:

6.11.9.2 General Exhaust Provisions: Exhaust systems shall be provided for toilets, hazardous material storage rooms, equipment rooms, and other areas as designated. All exhaust discharge outlets shall be located above the building roof line and located to prevent short-circuiting to air intakes or other building openings. Exhaust fans shall be located at the end of the exhaust duct run (exhaust ducts to be under negative pressure).

6.11.9.3 Space Pressurization: Where a negative or positive pressurization are required for a given space, that pressurization shall be maintained by the HVAC system under all conditions of operation.

6.11.10 HVAC System Controls:

6.11.10.1 Building Automation and Control System: The building automation and control system shall be a direct extension and fully compatible with the existing base wide Siemens Apogee System 600 direct digital control system for control of the heating, ventilating and air conditioning (HVAC) and other building systems. The extension of the existing system shall be integrated to the Langley Air Force Base base wide ethernet network using TCP/IP and be fully compliant with the current Siemens building automation system DIACAP and integrated to the existing Siemens Apogee Insight graphic computer server. The extension of the existing system shall also be integrated to the base wide supervisory monitoring and control (M & C) system using the existing Siemens InfoCenter and Utility Cost Management software package.

The system shall be used to perform supervisory monitoring and control functions including but not limited to scheduling, alarm handling, trending, downloading memory to field devices, parameter change of properties, set point adjustments, configuration of operators, execution of global command, report generation plus Electrical Peak Demand Limiting and Anti-terrorist emergency shutdown in accordance with the existing Base protocols. The Contractor shall extend the existing front end interactive user interface and provide a graphical representation for each building level system (AHU's, fans, pumps, chillers, boiler, etc.), provide access to real-time data for building level systems, provide the ability to override points in the building level systems, and allow for access to all supervisory monitoring and control functions at the building level. Software graphics shall include color floor plans with heating and cooling zones and the display of mechanical components that reflect the type of system and zones served.

6.11.10.2 The system shall be open in that it is designed and installed such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without further dependence on the original hardware vendor or their agents. This includes, but is not limited to the following:

Hardware shall be installed such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.

Necessary documentation (including rights to documentation and data), configuration information, configuration tools, application programs (with comments explaining program logic), application source code for programmable controllers, drivers, and other software shall be licensed to and remain with the Government such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor.

6.11.10.3 All DDC Hardware shall:

Conform to base wide addressing schemes, particularly with regard to Device ID.

Be capable of responding to Who-Is/I-Am and Who-Has/I-Have service requests.

All setting and parameters used by the application shall be fully configurable for the following:

- Setpoint
- Alarm limit
- Schedule modification
- Trend modification

Provide objects, properties, and services required to support the application and supervisory monitoring and control functionality including:

- System start/stop and overrides
- Scheduling
- Alarming
- Trending
- Be BTL listed

6.11.10.4 Include any device capable of communicating over IEEE 802.3 (Ethernet) in a DIACAP and Certificate of Networkiness (CoN) for this installation, regardless of whether the Ethernet connection is active at time of installation. Do not use devices with Ethernet connection capability not included in a DIACAP or without a DIACAP or without a CoN shall not be used.

6.11.10.5 Gateways may be used provided that each gateway communicates with and performs protocol translation for control hardware controlling one and only one package unit.

6.11.10.6 Configure M&C Software functionality including: graphical pages for System Graphic Displays including overrides, alarm handling, scheduling, trends for critical values needing long-term or permanent monitoring via trends, and demand limiting.

6.11.10.7 Configure M&C Software to provide hierarchically arranged screens to allow operator to configure all devices on the installation Ethernet Network. The following adjustments shall be supported:

Setpoints

Alarm limits

Schedules

Trends

This requirement is separate from and in addition to the requirement to provide all necessary programming and configuration software.

6.11.10.8 Perform all necessary actions needed to integrate legacy systems to the UMCS. Configure M&C Software functionality including: graphical pages for system Graphic Displays including overrides, alarm handling, scheduling, trends for critical values needing long-term or permanent monitoring via trends, and demand limiting. Integration may be via drivers in the M&C Software or hardware gateways may be provided. Where hardware gateways are provided, include all hardware, software, software licenses, and configuration tools required for gateway operation, modification, and maintenance. Configure software driver or a hardware gateway to support M&C Software functionality as listed above.

6.11.10.9 Provide the following to the Government for review prior to acceptance of the system:

The latest version of all software including source code for application software (for programmable controllers), software licenses, and user manuals required to program, configure and operate the system.

Points Schedule drawing that shows every DDC Hardware device. The Points Schedule shall contain the following information as a minimum for each device:

- Device ID and network address TCP/IP network and MAC address, or IP address).
- Input and Output Objects including Name, Type, Description, and relevant supported or required Properties.
- Hardware I/O, including Type (AI, AO, BI, BO) and Description.
- Alarm information including alarm limits and device IDs, object IDs, and property information.
- Supervisory control information including device IDs, object IDs, and properties for trending and overrides.
- Objects and Properties needed for device configuration.
- Device IDs and objects (where applicable) of remote devices and objects that communicate with the given Device.
- Example Points Schedules are available at: HYPERLINK "https://eko.usace.army.mil/fa/besc/"<https://eko.usace.army.mil/fa/besc/>

Riser diagram of the network showing all network cabling and hardware. Label hardware with Device IDs, network addresses, network names, and locations.

A consolidated list of all Device IDs.

Control System Schematic diagram and Sequence of Operation for each controlled system.

Operation and Maintenance Instructions including procedures for system start-up, operation and shut-down, a routine maintenance checklist, and a qualified service organization list.

Control system As-Builts: The Controls Contractor shall submit final as-built shop drawings in a hard copy and on CD-ROM in AutoCAD format.

Quality Control (QC) checklist (below) completed by the Contractor's Chief Quality Control (QC) Representative.

**Table 5-1: QC Checklist**

Instructions: Initial each item, sign and date verifying that the requirements have been met.		
#	Description	Initials
1	All DDC Hardware is installed on a TCP/IP local control bus	
2	All sequences are performed using DDC Hardware	
3	All software has been licensed to the Government	
4	Final As-built Drawings accurately represent the final installed system	
5	O&M Instruction have been completed and submitted	
6	All DDC hardware connected or intended to be connected to the IP network covered under a DIACAP and has a certificate of Networthiness	
7	M&C software monitoring displays have been created for all building systems, including all override display points indicated on Points Schedule Drawings.	
<p>By signing below I verify that all requirements of the contract, including but not limited to the above, have been met.</p> <p>Signature: _____ Date: _____</p>		

6.11.10.10 Perform a Performance Verification Test (PVT) under Government supervision prior to system acceptance. During the PVT, demonstrate that the system performs as specified, including but not limited to demonstrating that the system is Open and correctly performs the Sequences of Operation.

6.11.10.11 Provide a one year unconditional warranty on the installed system and on all service call work. The warranty shall include labor and material necessary to restore the equipment involved in the initial service call to a fully operable condition.

6.11.10.12 Provide training at the project site on the installed building system. Upon completion of this training each student, using appropriate documentation, should be able to start the system, operate the system, recover the system after a failure, perform routine maintenance and describe the specific hardware, architecture and operation of the system.

6.11.10.13 Air Handling Unit Controls: All AHU systems serving office and support areas shall be provided with supply and return fans with economizer operation. Fan speeds shall be modulated by means of variable speed motor controllers. Supply fans shall modulate based upon maintaining a fixed static pressure at a location remotely located in the ductwork sufficient to assure operation of all VAV terminal devices. In accordance with the requirements of ASHRAE 90.1, the static pressure setpoint shall be reset based on the zone requiring the most pressure. The setpoint shall be reset lower until one zone damper is nearly wide open. Supply, return, and outside airflow rates shall be measured by the DDC control system, and the return fan shall modulate to maintain a fixed differential airflow below that of the supply fan. A high supply duct static sensor and low temperature sensor (freeze stat) for shutdown capability shall be provided. Temperature controllers shall maintain space temperature within +/- 2 degrees F.

6.11.10.14 Temperature control shall be provided for distinct individual thermal zones. Temperature sensors shall be adjustable by the occupant and shall indicate space temperature. Temperature sensors shall have adjustment limits set by the DDC system to prevent over cooling or overheating.

#### **MECHANICAL AND ELECTRICAL SYSTEMS NOISE AND VIBRATION CONTROL**

6.11.10.15 Mechanical Systems Design: Careful consideration shall be made to the selection, location and installation of mechanical system components to insure compatibility with the building occupants and functional requirements. The misapplication of mechanical system components and their relationship to adjacent spaces can result

in unwanted noise that may impede the facility function. The sections that follow address specific parts of the design approach for mechanical system noise and vibration control. These sections present general guidelines, and do not replace detailed engineering analysis.

6.11.10.16 Duct-Borne Fan Noise: Whenever practicable, equipment shall be specified and selected on the basis of low noise level output; designers shall schedule the maximum sound power output, per each octave band, for air handling unit fans.

6.11.10.17 Air-Generated Noise: The movement of air for heating and ventilating systems generates noise related to turbulent airflow. Size air distribution supply, return and exhaust fixtures (diffusers, grilles, registers) to provide inlet/outlet velocities consistent with room NC level requirements as provided in UFC 4-510-01 Appendix A.

6.11.10.18 VAV/CAV Terminal Units: Schedule units with minimum inlet sizes for incremental ranges of flow, and indicate maximum sound power output for octave bands 2-7 for each unit at the maximum inlet static pressure to which the unit will be exposed.

6.11.10.19 Airflow velocities: Listed below are the approximate ranges of airflow velocities at the face of the terminal devices and in the last 3 to 6 feet of duct serving a space, required to achieve specific ambient noise levels. These noise levels are represented by NC (Noise Criteria) curves and assume no additional noise contribution due to duct-borne fan noise or air turbulence.

Noise Criterion Terminal Airflow Velocity  
(NC) Range (feet per minute)  
NC-25 to NC-30 (350 to 425)  
NC-30 to NC-35 (425 to 500)  
NC-35 to NC-40 (500 to 600)

6.11.10.20 Vibration Isolation: All vibrating equipment shall be resiliently isolated on vibration isolation systems to reduce the transmission of structure-borne noise, according to manufacturers' recommendations.

6.11.10.21 Flanking transmission: Flanking transmission of vibration energy from mechanical equipment shall be minimized. All connections to vibrating equipment shall be through flexible connectors, conduits, piping, or hose. All piping in mechanical equipment spaces connected to vibrating equipment shall be supported by resilient ceiling hangers or floor-mounted resilient supports. Penetrations through equipment room walls and ceilings shall be oversized, packed with a resilient material such as glass fiber or mineral fiber, caulked airtight, and covered with escutcheon plates where required for fire ratings. Piping should be supported on both sides of the penetrations and shall not rest on the structure.

6.11.10.22 Plumbing Noise:

6.11.10.22.1 Piping isolation: At wall and floor penetrations, water piping runs shall be free from the structure and the opening packed with a resilient insulation material and fully caulked. Water supply pipes larger than 2 inches in diameter shall be suspended from the structure on neoprene-in-shear hangers. Flexible pipe connectors will be used to connect the supply and drain pipes to vibrating equipment.

Integrate the control system to the installation's existing UMCS. The existing UMCS is Siemens APOGEE

Provide M&C Software with a license for no less than 1 clients

Provide M&C Software with a license for no less than 50 points.

## 6.12. ENERGY CONSERVATION

### 6.12.1. General

6.12.1 Inclusion of Renewable Energy Features. The following renewable energy features have been determined lifecycle cost effective, are included in the project budget and shall be provided.

The design of the new Paint Hangar includes an 80%recirculation/20% exhaust laminar air flow system to provide the environmental conditions in the Paint Hangar. The result will be a significant reduction in energy consumption compared to the 100% exhaust air systems in the two existing Paint Hangars.



6.12.2. Inclusion of Renewable Energy Features. The following renewable energy features have been determined lifecycle cost effective, are included in the project budget and shall be provided:

[Not Supplied - PS\_EnergyConservation : RENEWABLE\_ENERGY\_FEATURES]

### 6.13. FIRE PROTECTION

All life safety and fire protection requirements for this project shall be determined by a fire protection engineer of record in accordance with Section 4.0 APPLICABLE CRITERIA, Specified herein standards, ETL's and requirements:

- Latest UFC 3-600-01 Design: Fire Protection Engineering for Facilities.
- Air Force Engineering Technical Letter (AF ETL) 02-15: Fire Protection Engineering Criteria - New Aircraft facilities.

NFPA 11 Standard for Low-, Medium-, and High-Expansion Foam (2010)

- NFPA 101, Life Safety Code (2009)
- IBC, International Building Code (2006) as amended by latest UFC 1-200-01.
- NFPA 409, Standard on Aircraft Hangars (2004)

NFPA 1141, Standard for Fire Protection in Planned Building Groups (2008)

- AF ETL 02-15 takes precedence over the UFC 3-600-01, NFPA 101. NFPA 409 per AF ETL 02-15 Note 6, Specific Requirements, and UFC 3-600-1 Section 1-3.5 and 6-16.

#### 6.13.1.1 LIFE SAFETY

Preliminary considerations for life safety are listed below but are subject to actual design development and confirmation of the scope of work by future design authorizations.

6.13.1.1.1. Occupancy classification: This building is designed to be a mixed occupancy facility. The occupancies present in the buildings as defined by the codes are as follows:

- Aircraft Paint Bay: Group S-1 (IBC 311.2), Storage (NFPA 101 6.1.13).
- Hazard and Paint Storage Rooms: Group S-1 (IBC 311.2), Storage (NFPA 101 6.1.13).
- Staging Area: Group F-1 (IBC 306.1), Industrial (NFPA 101 6.1.12).
- Offices: Group B (IBC 304.1), New Business (NFPA 101 6.1.11)
- The hangar is a Group III Aircraft Hangar: NFPA 409 4.1.3
- Incidental use areas present include mechanical spaces and small storage areas.

6.13.1.1.2 Allowable floor areas and height limitations: The building is allowed to have unlimited area per AF ETL 02-15 A1.1.1.3.1. This is allowed by the building being fully sprinkled with proper water supply, meeting the building separation requirements, and internal separation requirements. The height of one-story aircraft hangars, aircraft paint hangars shall not be limited per IBC 504.1 Exception.

6.13.1.1.3. Construction Type: Minimum Type IIB construction (IBC) or NFPA Type II (000) construction shall be provided per AF ETL 02-15 A1.1.1. Walls separating the aircraft paint bay are masonry. The structure is unprotected steel. The floor is painted concrete. The roof is of Class A type roof material.

6.13.1.1.4. Fire Resistance Ratings: IBC Type IIB construction or NFPA Type II (000) construction does not require any fire rating of elements but it must be non-combustible.

6.13.1.1.5. Building Separation and Exposure Protection: There is no property line within 10 ft on the facility. This exceeds the distance triggering exposure protection in IBC Table 602.

6.13.1.1.6. Interior Fire Separation and Barriers:

- Occupancy separations: None is required by the IBC since this is a non-separated, mixed-use occupancy.
- Area separations: Between Aircraft Paint Bay and Staging area: 1 hour per AF ETL 02-15 A1.1.1.2.1 and NFPA 409 5.2.3, 5.2.4.
- Other separation: Aircraft Paint Bay: Per AF ETL 02-15 A1.1.1.2.1 requirements, a 1-hour fire rated masonry walls extending from floor to roof deck shall be provided to separate all other operations from the aircraft Paint bay. Opening protectives in these walls are to be 45 minute rated and be automatic closing or self closing.
- Paint Booth: Either the factory fabricated paint booth or the paint booth room is to be enclosed in a 1 hour fire rated assembly per NFPA 33 section 5.1.6.
- Hazard Storage and Paint Storage Rooms: Provide at least a 2-hour fire-rated separation from other areas per NFPA 33 section 8.2.2.
- Mechanical / Fire Protection Room: Provide 1 hour fire separation per AF ETL 02-15 A1.3.4.3.

6.13.1.1.7. Interior Finishes: Interior finishes will comply with the requirements of UFC 3-600-01 2-6 and NFPA-101 chapter 10. It is anticipated that finishes will typically be Class A or B.

6.13.1.1.8. Electrical Equipment classification: Install class I Division 1 or Class I Zone 1 electrical equipment throughout in hangar paint bay, hazard storage room and paint storage room per AF ETL 02-15 A 1.1.2.3.4. And NFPA 33.

6.13.1.1.9. Means of Egress:

## 6.13.1.1.9.1 Occupant Load

- Occupant Load Factors (NFPA 101, 7.3.1.2)
- Egress Capacity Factors: Egress component capacity shall be based on the following per NFPA 101, 7.3.3.1:
  - a) Stairways: 0.3 in/person
  - b) Level Components and Ramps: 0.2 in/person
  - c) Minimum Width of Any Egress Components: 36 in (NFPA 101 7.3.4)

## 6.13.1.1.9.2 Occupant Load &amp; Egress Capacity: (NFPA 101, 7.3.3.1)

Number of means of egress: The number of means of egress required by NFPA-101 is based on the calculated occupancies of each are of the building. Two are required except as noted below.

- Travel Distance Limits: (NFPA 101, Table A-7.6)

## Maximum Allowed Travel Distances, Feet

Occupancy	Exit Dist.	Dead End Corr.	Common Path
Business	300 ft	50 ft	100 ft
Aircraft Hangar Bay	150 ft	Not Permitted	Not Permitted
Industrial, General	250 ft	50 ft	100 ft

The Aircraft Paint bay is required by NFPA 101 section 42.6.1.2 to have exit doors on the exterior walls not to exceed 150 ft on center or horizontal exit doors spaced to not exceed 100 ft on center.

Mechanical Mezzanines: Mechanical mezzanines are allowed to have a single exit as the common path of travel to the bottom of the stairs is less than 75 ft. (NFPA 101, 42.6.2.)

- Roof Access: NFPA 409 5.5.4 requires roof access.
- Discharge from Exits:
  - General: Exit discharge is designed to meet requirements of NFPA 101, 42.6 and 7.7.
  - Level of Exit Discharge: At the level of exit discharge, exits discharge directly to the outside of the building leading to a public way.
- Illumination of Means of Egress: Exit are illuminated per NFPA 101, 7.8.
- Emergency Lighting: Emergency lighting is required by NFPA 101 38.2.9.1(1). It is provided in accordance with provisions of NFPA-101 7.9.
- Exit Markings: LED exit signs shall be provided in accordance with NFPA-101 7.10.

## 6.13.1.1.9.3 Accessible Means of Egress

- Ground Floor: The ground floor is accessible with accessible exit access through the exits to public ways per NFPA 101 section 7.5.4, ABA and UFAS requirements.
- Mechanical Mezzanine: The mechanical mezzanines are not constructed to be accessible as work requires able bodied personnel to perform the work.

6.13.1.1.10. Vehicle Access shall be provided, as required by UFC 3-600-01. Dimensions of fire lanes and turnarounds must comply with NFPA1 "Fire Code".

## 6.13.2. FIRE PROTECTION

6.13.2.1. Summary: This F22 Add / Alter Hangar Bay LO/CR Paint Facility is to add one additional aircraft paint hangar to an existing facility having three paint hangars. It is required to meet the most stringent fire suppression requirements specified in UFC 3-600-01 - Fire Protection Engineering for Facilities, and ETL-02-15 - Fire Protection Engineering Criteria - New Aircraft Facilities. It shall be protected with a wet sprinkler system for the staging area, equipment rooms, and office areas. Stacks or ducts and Plenum shall be protected with an automatic dry sprinkler system. The hangar paint bay shall be protected with a Low Level High Expansion Foam system (HEF) and a wet pipe suppression system. A new fire protection equipment room is provided for this new addition. Required fire alarms system meeting the requirements as outlined in AF ETL 02-15 shall be provided. Mass Notification System (MNS) meeting UFC 4-021-01 shall be provided in the new addition. As a bid option #2, provide MNS in the existing facility.

Install class I Division 1 or Class I Zone 1 electrical equipment throughout in hangar paint bay, Plenum, hazard storage room and paint storage room per AF ETL 02-15 A 1.1.2.3.4. and NFPA 33.

6.13.2.2. Fire Detection and Alarm System: Fire detection and alarm shall be provided in two independent yet interconnected systems, the High Expansion Foam System Controls (FSC) and the general building Fire Detection and Alarm System (FAS). The design includes on a new Monaco BT-X transceiver which will interface with the existing Base wide 'Monaco' D-21 Central reporting station. These systems are to be designed in accordance with the Base Design Guide, AF ETL 02-15, UFC 3-600-01, NFPA 72 and NFPA 70 requirements.

a) Existing equipments: The existing Fire Alarm System Control Panel (FACP) is Siemens MXL-IQ, and the Transceiver is Monaco BT2-8, which both are located at the existing Electrical Room 140. The existing Foam suppression Control Panel (FSCP) is FCI FC-72 series fire alarm control panel and the Transceiver is Monaco BT2-7, which both are located at the existing fire protection equipment Room 102.

b) Existing equipment capacities: The existing FACP has the capacity to handle the expansion of adding new additional hangar paint bay. The transceiver BT2-8 is full. It will be replaced with a new BT-X transceiver. The Existing FSCP and its transceiver BT2-7 will remain and it will be untouched and unchanged.

c) Fire Alarm Control Panels and Transceiver: Use the existing FACP for the new addition. And a new Monaco BT-X transceiver shall be provided to replace the existing BT2-8 and it will be located in the electrical Room 140. The system shall have the capacity to report each zone, including spare zones, to the central reporting station on the base.

d) Duct Smoke Detectors: Photoelectric duct type smoke detectors are provided in both the supply and return on air handling units moving more than 2,000 cfm. Fan shutdown relays with manual reset shall to be provided. The manual reset switch as well as a remote test switch, and LED indicator for maintenance and alarm identification are to be mounted on a common enclosure at 7 feet above finish floor elevation near each detector.

e) Fire Alarm Notification: Visual and audible fire alarm notification is to be provided by wall or ceiling mounted combination horn/strobes and stand-alone strobes. Devices will be red and labeled "fire" or "fire alarm" in white lettering. White strobes will be provided it indicate the building is to be evacuated. Strobes are to be located as required by ABA and NFPA 72 and additionally in all occupied rooms as well as toilet/locker rooms. Strobes will be synchronized throughout the facility as well as with any Mass Notification System Strobes provided.

f) HEF Foam Control System: A new HEF control system shall be provided in the new HEF room. A new FSCP shall be located in new HEF room. The system is specified to be capable of stand-alone operation in all conditions with battery back-up power.

- Activation for the high expansion foam system shall be by manual pull station and by the flow switch of overhead hangar bay wet sprinkler system. Manual foam discharge stations are provided inside the aircraft servicing area at all exits. These stations are the locking type such that when activated they require a key to be reset and the replacement of no parts. See AF ETL 02-15.

- Dead man type abort stations shall not be provided. Provide cover for manual high expansion foam pull stations to protect them from accidental activation. Mark them "fire protection foam".

- Notification: Combination horn/strobes on the walls of the aircraft paint bay notify occupants of imminent HEF FOAM discharge. Devices are specified to be white and labeled "FOAM" in blue lettering.

- When the HEF system is activated, the trench drain diverter valve shall open to drain the water of hangar bay to dedicated existing HEF drainage system.

g) All fire alarm, MNS, and HEF system's equipment: Install class I Division 1 or Class I Zone 1 electrical equipment throughout in hangar paint bay, Plenum, hazard storage room and paint storage room per AF ETL 02-15 A 1.1.2.3.4. and NFPA 33.

h) It is acceptable that new explosion-proof equipments to be installed in the new hangar bay to match existing explosion-proof equipment, which were installed in the existing hangar paint bay.

6.13.2.3. Mass Notification System (MNS): The new MNS shall be provided only in a new addition. A new MNS control panel shall be specified the capacity for entire building, including all existing areas. It will be located in new HEF room. Mass notification provides real-time information to all building occupants or personnel in the immediate vicinity of a building during emergency situations per IAW UFC 4-021-01. A notification appliance network consists of a set of audio speakers located to provide intelligible instructions at all locations in and around the building. Strobes are also provided to alert hearing-impaired occupants.

- Control units will have the following general features:
  - Able to function independently upon failure of a base-wide control system
  - Independent of fire alarm system
  - Ability to temporarily deactivate fire alarm audible notification appliances while delivering voice messages
  - Conductor integrity monitory for strobe, display, temporary deactivation of fire alarm audible notification appliances, and speaker wiring
  - Secure local operator console for initiating recorded messages, strobes and displays and for delivering live voice messages
  - Capacity for at least four prerecorded messages
  - Ability to deliver messages quickly
  - Ability to automatically repeat prerecorded messages until terminated
  - Secure microphone for delivering live voice message
  - Adequate discrete outputs to temporarily deactivate fire alarm audible notification appliances, initiate optional textual displays, and initiate/synchronize strobes
  - Complete set of self diagnostics for the controller and appliance network
  - Local diagnostic information display
  - Local diagnostic information and system event log file
  - Interface for communication with base wide control system for mass notification
  - Ability to relay local diagnostics information to central control units
  - Available backup communication link
- Mass Notification System shall be capable for use as a paging system. The system shall be initiated by the local operating consol unit, or the facility phone system. Volume control will be provided at the speaker.

6.13.2.4. (Option #2): As a bid option #2, add MNS throughout the entire existing facility.

6.13.2.5. Fire Extinguishing Systems

6.13.2.5.1 Automatic fire Sprinkler System:

- a) An automatic fire sprinkler system covering the entire building is required by AF ETL 02-15. This design will conform to the requirements of these standards and UFC 3-600-01 and NFPA-13.
- b) An automatic dry sprinkler system will be provided to protect stacks or ducts and Plenum (for all filter plenum exhaust air ductwork and stacks downstream of the filter wall) per NFPA 33 9.4.6:
  - Sprinklers shall be spaced no more than 3.7 m (12 ft) apart.
  - If exhaust ducts are manifolded, a sprinkler shall be located in the manifold at the junction of each exhaust duct with the manifold.
  - Sprinklers shall provide a minimum flow of 114 L/min (30 gpm) per head at a minimum of 1 bar (15 psi) pressure.
  - Sprinklers shall be ordinary temperature rated, unless required to be higher due to operating temperatures measured in the ducts, in which case the operating temperature shall be at least 28°C (50°F) above the inside temperature of the duct.
  - Stacks and exhaust ducts shall be provided with access openings for inspection and cleaning of sprinklers.
- c) Equipment room and Office Sprinkler System: A wet type sprinkler system will be installed to protect the office and equipment rooms.
- d) Hangar paint bay sprinkler system: A wet type sprinkler system is specified to protect the aircraft paint bay. It is designed to provide 0.2 gpm/sf over the remote 5,000 sf. The remote area must be increased by 30% for sloped roof that exceed a pitch of one in six. The system riser is located in the new foam equipment room.

e) Freeze Protection for hanger bay: Temperature sensors are specified to be located at the same level as the sprinklers. The temperature detection system will be monitored by the building EMCS system. The EMCS will have a digital output monitored by the Building Fire Alarm Panel. When a low temperature switch senses the temperature below the set point of 33°F for more than 10 minutes (adjustable), an alarm will be issued to the HVAC shop and fire alarm panel. The Fire Alarm panels will relay this alarm to the fire department as a supervisory alarm. If nuisance alarms become a problem for the fire department, a longer delay in notifying the fire department can be programmed into the EMCS controls or the supervisory signal eliminated all together.

f) Sprinkler System Fire Hazard Classifications: Building area will be classified as listed in UFC 3-600-01, Appendix B; NFPA 13 2-1.

g) System Details

- System Design: The HEF and sprinkler systems is specified to be hydraulically design to supply the listed demands yet have flow velocities not exceed 10 fps in underground piping and 20 fps in the above ground piping.
- Wet System: Wet system risers are detailed to have an OS&Y gate valve, riser check valve with trim, 2" main drain, paddle type flow switch, and inspector test valve assembly.
- System Drains: System piping are specified to slope to drain back to a main drain at the riser where possible, Drain lines are routed outside and discharge onto a cast in place concrete splash block or by a similar method to control runoff and erosion at the facility. Where it is not possible to drain the system back to the riser, auxiliary drain valves are specified to be provided. They will be fully accessible and the valve will be located no higher than 7'-0" AFF.
- Fire Department Connection: A brass fire department connection with two 2½" hose connection in a "y" pattern is detailed to be located on the exterior wall of the fire equipment room. It is arranged through check valves to only feed the sprinkler systems and not the HEF system.

h) Equipment and Components:

Sprinkler Heads:

- Hangar Bay: Sprinkler heads are specified to be 175°F, upright, intermediate temperature, quick-response type.
- Unfinished Spaces: Quick-response up-right and pendant brass heads are specified to be used in unfinished areas.
- Finished Spaces: Chrome plated quick-response recessed pendant type heads are specified in finished areas with ceilings.

i) Piping: Sprinkler system piping is specified to be ASTM A53 or A795 schedule 40 pipe. The system components are rated for a maximum system operating pressure of 175 psig. Fittings are to be screwed type for pipes 2" and smaller and welded flanged or roll-grooved mechanical fitting on 2½" and larger pipe. All classes of fittings (screwed fitting, mechanical couplings, etc...) are required to be from the same manufacturer.

j) Valves: All sectional and isolation valves are to be OS&Y type with tamper switches.

k) Expansion Tank: 10 gallon surge arrester / expansion tanks are specified to be Parker Surgekuson or approved equal and the installation will include charge pressure gage, isolation valve, and drain line. The tank is connected to the rise on the supply side of the gate valve.

l) Pipe Support: Fire protection piping is specified to be supported directly from the building structure members. All support systems are specified to include full lateral and horizontal bracing. Design of support is to comply as a minimum, with seismic criteria as outlined in NFPA 13 and UFC 4-010-01 force protection requirements. No other equipment or materials is allowed to be supported from the fire protection support system. Pipe penetration of wall must use pipe sleeves with the voids filled with silicone at non-rated walls and fire stopping listed for that installation at rated walls. Escutcheons are specified where exposed pipes penetrate a wall in a finished room.

m) System Painting and Identification: All exposed sprinkler system piping in finished areas except stainless steel piping is to be finish painted in facility coordinated color. Piping in unfinished areas is not specified to be painted. All piping in the fire equipment room shall be painted in red. All piping is specified to be provided with identification and flow markings at intervals not to exceed 26 feet. System signage is specified per the requirements of NFPA-13.

#### 6.13.2.5.2 High Expansion Foam (HEF) System:

HEF system protecting the aircraft paint bay is required by AF ETL 02-15. The design conforms to the requirements of these standards and NFPA-11.

- a) HEF Equipment: A foam concentrate storage tank and proportioning equipment is required. A test header with connections is located in the hangar bay.
- b) HEF System Controls: The foam system discharge is controlled by a Foam System Control Panel (FSCP). This system is completely stand-alone with respect to the building's general Fire Alarm System (FAS), only reporting trouble, supervisory, and alarm conditions. Foam system discharge is triggered by activation one of the following devices: Water flow switch in the service bay's overhead fire sprinkler system, or any manual foam system pull station located at all exits of hangar paint bay.
- c) System Performance Requirements: The HEF system is designed to cover 90% of the silhouette of a F22 aircraft's main wings and fuselage in its normal parking position within one minute of the system being activated. It is also designed to fill the entire paint bay 1 meter deep within 4 minutes. The system has the capacity to produce foam for 15 minutes.
- d) System Arrangement: The system consists of foam generators suspended from the structure of the hangar arranged in a pattern to facilitate the coverage of the floor. Generators will use indoor air in generating the foam. Proportioners in the HEF Equipment Room mix foam concentrate and water in the manufacturer's prescribed proportions for use at the generators. A bladder tank is used to hold and feed concentrate to the proportioner.
- e) The foam generators shall have covers to prevent paint overspray. It is acceptable to match the existing type of foam generators.
- f) HEF Risers: The HEF riser mixes concentrate and water in the proper ratio using a pressure type proportioner. Deluge valves are used to release the systems and activate the water powered ball valve controlling concentrate discharge from the bladder tank. An OS&Y gate valve is provided to isolate each foam riser and also the bladder tank. A 10 gallon surge arrester tank with charge pressure gage, isolation valve, and drain line are detailed to be connected to the rise on the supply side of the gate valve.
- g) HEF System Piping: All system components are specified to be rated for 175 psig working pressure. Like components must be from the same manufacturer.
  - Foam Solution and Fire Water Piping: Foam-water solution piping is specified to be ASTM A795 schedule 40 pipe per the requirements of AF ETL 02-15. No galvanized piping including riser trim is to be allowed. Fittings on the solution piping will most likely be roll-grooved mechanical type on pipes 2½" and larger and screwed malleable iron fittings on pipe 2" and smaller.
  - Foam Concentrate Piping: Foam concentrate piping is specified to be schedule 40 stainless steel pipe with welded or flanged joints per the requirements of AF ETL 02-15 with two exceptions, at the connection to the proportioner and the bladder tank.
- h) System Drains: System piping is detailed to be sloped to drain back to a main drain at the riser as much as possible. It is routed outside and discharged onto a cast-in-place concrete splash block or a similar method to control runoff and erosion at the facility. Where it is not possible to drain the system back to the riser, auxiliary drain valves are to be provided. They are specified to be fully accessible and the valve be located no higher than 7'-0" AFF.
- i) System Painting and Identification: All exposed HEF system piping in finished areas except stainless steel piping is to be finish painted in facility coordinated color. Piping in unfinished areas is not specified to be painted. All piping is specified to be provided with identification and flow markings at intervals not to exceed of 26 feet. System signage is specified per the requirements of NFPA-13.

#### 6.13.2.5.2 Fire Water Source:

- a) General: Facility fire protection system shall be served from an existing fire pump house (bldg 348) and storage tank (bldg 347). The fire pump house contains (4) - 2,000 gpm diesel-driven fire pumps at 100- psi discharge and 400,000 gallons of water storage. Refer to Appendix D for fire pump tests details.
- b) Fire protection contractor shall hydraulically design the systems based on a residual pressure of 100 psi available at the existing fire pumphouse.

- c) Building Fire Water Entrance: A 10" dedicated fire line from the pump house will feed the HEF equipment room. It enters the building through the side wall of a pit in the HEF equipment room per AF ETL 02-15 A1.3.1.6.4.
- d) Entrance Piping: Underground piping to the PIV outside the HEF room is AWWA C900 PVC pipe. Piping from the PIV to inside the pit is AWWA C200 Steel pipe. Inside the building it reduces down to 8" or 6" depending on the final hydraulic calculations. Penetration of the pit wall is detailed to be sleeved and sealed water tight. The piping from there to the system risers is specified to be ASTM A53B or A795 schedule 40 steel pipe with corrosion protective coating. Joints are welded or flanged. A basket strainer with gate valves on either side is detailed to be installed in the main. No backflow preventer is needed since the water supply is from a non-potable source.
- e) Fire Protection System Commissioning: A commissioning procedure is specified to verify the installation is installed according to the all standards. The commissioning process incorporates NFPA forms for the systems installed.
- f) Fire Suppression System Training: At least 1 week of training is specified to be provided by factory instructors or factory trained and authorized instructors for all equipment and systems. Training will be complete with all materials, fees and tuition covered by the contract except employee travel costs. A DVD will be provided on all training on the HEF system.

#### 6.13.2.5.3 Manual Fire Extinguishers:

- a) General: Recessed or semi-recessed fire extinguishers cabinet are located at all building exits, in or adjacent to each mechanical room, electrical room, communication room, shops. Additional extinguisher cabinets are provided as needed to allow one to be reached from any location in the building with a travel distance of 75 ft or less (NFPA-10 Table 3-2.1). Fire extinguisher cabinets are specified to be of heavy duty brushed stainless steel with eased corners and glass face, sized for 10 pound 4A:20B:C dry chemical extinguishers.
- b) No exterior extinguisher cabinets are required.

#### 6.13.2.5.4 Fire Hydrants:

- a) Fire hydrants are located around the hangar per ETL 02-15 and UFC 3-600-01.

#### 6.13.2.6. Protect the following from paint overspray: sprinklers, fire alarm, pull stations, foam generators and fire extinguishers.

#### 6.13.2.7. Fire Department Access:

- a) Building Exterior Access: Fire department access is provided on all sides of the facility as the closest structure is more than 40 feet away.
- b) Building Interior Access: A Knox Box allowing access to the HEF room and the hangar shall be provided. This allows for access to the annunciator panel in the main entrance. Power to the hangar door must be independent of the main building power supply to permit isolation of the power to the facility during a fire without interrupting power to door motors. Provide a key-operated or other access-controlled switch on the exterior of the facility for operation of power-operated doors to allow access from the apron during a fire event.
- c) Fire Apparatus Access: Vehicle Access: All weather drives are design to handle standard fire department equipment. Access shall be provided to a location that hoses from a fire hydrant to the fire truck and then to the fire sprinkler system's fire department connection is possible. Drives are provided on all sides of these facilities meeting the requirements of NFPA 1141.

#### 6.13.2.8. Smoke Management System:

- a) Aircraft paint Bay Air Movement Control: Air handling systems recirculation air in the paint bay will be interlocked with the foam system control panel to have all fans stopped on foam dump. Intakes are located at 10 feet or more above the hangar floor.
- b) Air Handling Unit Control: Duct type smoke detectors in the supply and return duct of air handling units larger than 2,000 CFM shut down these air handling system when smoke is detected. The smoke detectors are specified to be manually reset before the system is allowed to operate again.

#### 6.13.2.9. Miscellaneous:

- a) Hazardous Material Storage: Fire safe storage lockers is the basis of design regarding onsite storage of hazardous material such as paint.
- b) Drainage: AF ETL 02-15 section A1.1.2.1. requires the floors be sloped so that apron spills do not drain into the hangar and liquid spills in and outside the aircraft paint bay do not flow into the other area.
- c) Containment:
  - Spill containment of concentrate shall be provided in HEF room by a depressed area. An access path to FACP and FSCP panels is raised to allow access without walking through spills. The room shall be sloped to the containment though. The containment is sized for the capacity of the concentrate tank.



- Foam solution in the hangar paint bay will drain to the existing HEF foam drainage system.

#### 6.13.2.10. Signage:

All signage shall be specified to be in accordance with Air Force Pamphlet 32-1097, and the base standard signage supplied by the BCE. This includes interior signs for permanent offices, other permanent areas and required emergency identifiers.

### 6.14. SUSTAINABLE DESIGN

6.14.1. LEED Rating Tool Version. This project shall be executed using LEED-NC Version 3.

6.14.2. The minimum requirement for this project is to achieve LEED Silver level. Each non-exempt facility (building plus sitework) must achieve this level. In addition to any facilities indicated as exempt in paragraph 3, the following facilities are exempt from the minimum LEED achievement requirement: [Not Supplied - PS\_SustainableDesignGeneral : SD\_EXEMPT\_FACILITIES].

6.14.3. Credit Validation: LEED registration, compiling of documentation at LEED OnLine and use of the LEED Letter Templates is required. Registration and payment of registration fees will be by the Government. Administration/team management of the online project will be by the Contractor. Validation of credits will be accomplished by the Government. LEED certification of the project by the Contractor is required. The Contractor will obtain LEED certification prior to project closeout. Application, payment of certification of fees and all coordination with USGBC during the certification process will be by the Contractor. GBCI interim review of design phase data is not required by the Government but is recommended. Government validation during project execution does not relieve or modify in any way the Contractor's responsibility to satisfy all requirements for certification as defined by LEED and GBCI. Contractor is not responsible for design phase LEED documentation of any unaltered portion of the design that is accomplished by others. If the project includes unaltered complete design by others, during the certification process Contractor will coordinate all GBCI comments on LEED credits that fall outside Contractor's scope of responsibility with the Government for coordination with the Designer of Record, and Contractor will not be penalized if project fails to achieve certification at the minimum required level due to loss of credits that are the responsibility of others.

6.14.4. Commissioning: See Appendix M for Owner's Project Requirements document(s).

6.14.5. LEED Credits Coordination. The following information is provided relative to Sustainable Sites and other credits.

#### **SS Credit 1 Site Selection:**

Project site IS NOT considered prime farmland.

Project site is five feet or more above 100-year flood elevation.

Project site contains no habitat for threatened or endangered species.

No portion of project site lies within 100 feet of any water, wetlands or areas of special concern.

Project site WAS NOT previously used as public parkland.

#### **SS Credit 2 Development Density & Community Connectivity.**

Project site DOES NOT meets the criteria for this credit.

#### **SS Credit 3 Brownfield Redevelopment.**

Project site DOES NOT meets the criteria for this credit.

**SS Credit 4.1 Public Transportation Access.**

Project site DOES NOT meets the criteria for this credit.

**EA Credit 6 Green Power.**

35% of the project's electricity WILL NOT will be provided through an Installation renewable energy contract. Do not purchase Renewable Energy Credits (REC's) to earn this credit.

**MR Credit 2 Construction Waste Management.**

The Installation does not have an on-post recycling facility available for Contractor's use.

**Regional Priority Credits (Version 3 only)**

The project zip code is 23665.

6.14.6. LEED Credit Preferences, Guidance and Resources. See Appendix L LEED Project Credit Guidance for supplemental information relating to individual credits.

6.14.7. Not Used

6.14.8. Additional Information

6.14.8.1 LEED Strategy Table: See Appendix O, LEED Strategy Table, for LEED 2009 for New Construction and Major Renovation Checklist indicating strategy to achieve USGBC LEED Silver certification.

6.14.8.2 Air Combat Command (ACC) Sustainable Design and High Performance Green Building: The D-B firm shall meet statutory minimum requirements as stated in the ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics document (see Appendix OO) and implement additional SD&HPGB measures that, will in aggregate, achieve a minimum LEED Silver certification rating. Where the D-B firm has determined that a statutory minimum requirement cannot be met, accompanying Basis of Design justification shall be provided.

6.14.8.2.1 ACC Sustainable Design and High Performance Green Design Analysis and Scorecard: The D-B firm shall prepare a Project Sustainable Design & High Performance Green Design Analysis (SD&HPGD Analysis) which incorporates the ACC Sustainable Design and High Performance Green Building Scorecard. The SD&HPGD Analysis shall address each design objective and discuss how that objective is incorporated into the project; address why other features were not included; address the cost of high performance green features; address synergies between high performance green features; and clearly describe anticipated construction-phase sustainable design and high performance green building features. Maintain and update the SD&HPGD Analysis at each project phase to reflect objectives currently being met and those anticipated in subsequent phases. See Appendix PP for ACC Sustainable Design and High Performance Green Building Scorecard at RFP phase.

6.14.8.2.2 Substitutions: All substitutions that may directly or indirectly impact complying with the Energy Policy Act of 2005 shall be submitted to the Government for approval.

6.14.8.3 Commissioning: See Appendix QQ, Section 01 91 00 Commissioning and Section 07 25 00.00 06 Building Air Barrier System, for Langley AFB Base Standard Commissioning specification sections. The D-B firm shall modify sections as required for project requirements and appropriate level of Commissioning.

6.14.8.3.1 The D-B firm shall meet the requirements for building air tightness and air leakage testing as indicated in Appendix RR, Air Leakage Test Protocol, for the US Army Corps of Engineers Air Leakage Test Protocol for Measuring Air Leakage in Buildings.

6.14.8.3.2 (Option #3) Enhanced Commissioning: Provide LEED Enhanced Commissioning in lieu of LEED Fundamental Commissioning. Commission, at a minimum, all HVAC systems and equipment and associated controls, domestic hot water systems and associated controls, renewable energy systems and controls, life safety systems and controls, lighting and associated controls, emergency power and uninterruptable power systems and controls, electrical systems and controls, building automation systems, plumbing systems and components (including plumbing sensors, compressed air systems, breathing air systems, gas trains and vacuum dust evacuation systems), equipment sound control systems, vertical transport systems, security and access control systems, information and communication systems, building envelope, and public address/paging systems, as applicable, in accordance with ASHRAE Guideline 1.1, ASHRAE Guideline 0, LEED Energy and Atmosphere Credit 3, and ACC Enhanced Building Commissioning. The Contractor shall hire the Commissioning Authority (CA), certified as a CA by AABC, NEBB, or TABB, as described in Guideline 1.1. The CA will be an independent contractor and not an employee or subcontractor of the Contractor or any other subcontractor on this project, including the design professionals (i.e., the DOR or their firm(s)). The Contracting Officer's Representative will act as the Owner's representative in performance of duties spelled out under OWNER in Annex F of ASHRAE Guideline 0.

6.14.8.4 (Option #4) Measurement and Verification: Develop and implement a measurement and verification plan consistent with LEED Energy and Atmosphere Credit 5.2, Measurement and Verification. The D-B firm shall determine the optimal method to achieve credit requirements.

6.14.8.5 LEED Documentation: See Appendix SS, Section 01 33 29 LEED Documentation, for Langley AFB Base Standard LEED Documentation specification section 01 33 29. The D-B firm shall modify this section as required for project requirements and appropriate level of LEED certification.

6.14.8.6 Construction and Demolition Waste Management: See Appendix TT, Section 01 74 19.00 50, Construction and Demolition Waste Management, for Langley AFB Base Standard Construction and Demolition Waste Management specification section 01 74 19.00 50. The D-B firm shall modify this section as required for project requirements and appropriate level of LEED certification.

6.14.8.7 Operation and Maintenance Data: See Appendix UU, Section 01 78 23.00 50, Operation and Maintenance Data, for Langley AFB Base Standard Operation and Maintenance Data specification section 01 78 23.00 50. The D-B firm shall modify this section as required for project requirements and appropriate level of LEED certification

## 6.15. ENVIRONMENTAL

6.15.1 All work is to be performed in a manner that prevents pollution, protects the environment, and conserves natural and cultural resources and in compliance with all requirements noted in Appendix E and in Appendix AA.

6.15.2 The Contractor shall coordinate all work with (633d CES/CEA) Asset Management Flight.

6.15.3 A limited environmental investigation was performed in February 2010 and can be found in Appendix E. The report indicates that there were no detected concentrations of BTEX compounds, total petroleum hydrocarbons in the gasoline range (TPH-GRO), antimony, mercury, silver, or selenium. The report indicates that arsenic concentrations in the samples exceeded the EPA SL but that arsenic is a naturally occurring element in Virginia. Workers should wear appropriate Personal Protective Equipment (PPE) such as gloves and avoid ingesting dirt as a part of this project.

6.15.4 Any excavated material from the project that cannot be re-used on site, or has petroleum contamination must be trucked off base and disposed of properly in accordance with the Base Environmental Special Conditions (Appendix AA).

#### 6.16. PERMITS

The Contractor shall obtain all needed licenses and permits.

(a) Proper Stormwater permits must be obtained from the State of Virginia. Contractor shall provide a copy of Forms DCR 199-146 and any required plans and specifications including a SWPPP to Civil Engineering Office for review at least 30 days prior to submission to VA DCR. Contractor shall submit this registration and any required plans and specifications including a SWPPP to VA DCR at least 30 days prior to construction start.

(b) The Contractor must obtain a stormwater control permit from base Civil Engineering. Contractor shall provide a copy of any required plans and specifications to Civil Engineering Office for review at least 30 days prior to construction start.

(c) The Contractor must obtain a Work Clearance Request (Air Force Form 103) prior to beginning any excavation activities.

(d) The Contractor shall include in his price the time and effort needed to coordinate and assist Langley Compliance Program Manager Mr. Robert Jones, with the modification of the existing Air Quality Permit which can be found in Appendix VV. There is no permit fee associated with modification of this permit, so the only cost to the Contractor will be the labor needed to perform the calculations needed per VDEQ requirements and to amend the permit.

(e) See Appendix DD for a supplemental list of permits

#### 6.17. DEMOLITION

(a) Existing water, sanitary sewer force main, foam force main, electric duct bank, and telecommunications duct bank all must be relocated around the proposed new facility. All demolished utilities shall be disposed of in accordance with Section 01120 - Environmental Special Conditions.

(b) Concrete sidewalk, concrete curb and gutter and asphaltic pavement must be demolished and disposed of in accordance with Section 01120 - Environmental Special Conditions.

(c) Existing storm piping and storm structure(s) must be relocated around the proposed new facility. All demolished storm piping and structures shall be disposed of in accordance with Section 01120 - Environmental Special Conditions.

6.18. ADDITIONAL FACILITIES

This Paragraph is not used.

End of Section 01 10 00

**SECTION 01 32 01.00 10**  
**PROJECT SCHEDULE**

**1.0 GENERAL**

1.1. REFERENCES

1.2. QUALIFICATION

**2.0 PRODUCTS (NOT APPLICABLE)**

**3.0 EXECUTION**

3.1. GENERAL REQUIREMENTS

3.2. BASIS FOR PAYMENT AND COST LOADING

3.3. PROJECT SCHEDULE DETAILED REQUIREMENTS

3.4. PROJECT SCHEDULE SUBMISSIONS

3.5. SUBMISSION REQUIREMENTS

3.6. PERIODIC SCHEDULE UPDATE MEETINGS

3.7. REQUESTS FOR TIME EXTENSIONS

3.8. DIRECTED CHANGES

3.9. WEEKLY PROGRESS MEETINGS

3.10. OWNERSHIP OF FLOAT

3.11. TRANSFER OF SCHEDULE DATA INTO RMS/QCS

## **1.0 GENERAL**

### **1.1. REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

- U.S. ARMY CORPS OF ENGINEERS (USACE) ER 1-1-11 (1995) Progress, Schedules, and Network Analysis Systems <http://www.usace.army.mil/publications/eng-regs/er1-1-11/entire.pdf>
- Army Corps of Engineers ECB No. 2005-10, (31 August 2005) Scheduling Requirements for Testing of Mechanical Systems in Construction [http://www.wbdg.org/ccb/ARMYCOE/COEECB/ecb\\_2005\\_10.pdf](http://www.wbdg.org/ccb/ARMYCOE/COEECB/ecb_2005_10.pdf)

### **1.2. QUALIFICATIONS**

The Contractor shall designate an authorized representative who shall be responsible for the preparation of the schedule and all required updating (statusing) and preparation of reports. The authorized representative shall be experienced in scheduling projects similar in nature to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

## **2.0 PRODUCTS (Not Applicable)**

## **3.0 EXECUTION**

### **3.1. GENERAL REQUIREMENTS**

3.1.1. Submit a project schedule as specified herein for approval showing the sequence in which the Contractor proposes to perform the work and dates on which the Contractor contemplates starting and completing all schedule activities. The scheduling of the entire project, including the design and construction sequences is required. Contractor management personnel shall actively participate in its development. Designers, subcontractors and suppliers working on the project shall also contribute in developing an accurate project schedule. The schedule must be a forward planning as well as a project monitoring tool. The approved project schedule shall be used to measure the progress of the work and to aid in evaluating requests for excusable time extensions. The schedule shall be cost loaded and activity coded as specified herein. The schedule will provide the basis for all progress payments. If the Contractor fails to submit any schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule

3.1.2. Status the schedule on at least a monthly basis, as specified herein. If in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained. See paragraph 3.7.4.

3.1.3. Failure of the Contractor to comply with the requirements of the Contracting Officer shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of the contract.

### **3.2. BASIS FOR PAYMENT AND COST LOADING**

The schedule shall be the basis for determining contract earnings during each update period and therefore the amount of each progress payment. Lack of an approved schedule update or qualified scheduling personnel will result in an inability of the Contracting Officer to evaluate contract earned value for the purposes of payment. Failure of the Contractor to provide all information, as specified herein will result in the disapproval of the preliminary, initial and subsequent schedule updates. In the event schedule revisions are directed by the Contracting Officer and those revisions have not been included in subsequent revisions or updates, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until such revisions to the

project schedule have been made. Activity cost loading shall be reasonable as determined by the Contracting Officer. The aggregate value of all activities coded to a contract CLIN as specified herein shall equal the value of the CLIN on the Schedule.

### 3.3. PROJECT SCHEDULE DETAILED REQUIREMENTS

The computer software system utilized to produce and update the project schedule shall be capable of meeting all requirements of this specification. Failure of the Contractor to meet the requirements of this specification will result in the disapproval of the schedule. Scheduling software that meets the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER-1-1-11(1995) referenced herein are Primavera Project Planner (P3) by Primavera, and Open Plan by Deltek.

#### 3.3.1. Use of the Critical Path Method

Use the Critical Path Method (CPM) of network calculation to generate the project schedule. Prepare the project schedule using the Precedence Diagram Method (PDM).

#### 3.3.2. Level of Detail Required

Develop the project schedule to an appropriate level of detail. Failure to develop the project schedule to an appropriate level of detail, as determined by the Contracting Officer, will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

##### 3.3.2.1. Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities shall have Original Durations (OD) greater than 20 work days or 30 calendar days. Procurement activities are defined herein.

##### 3.3.2.2. Design and Permit Activities

Design and permit activities, including necessary conferences and follow-up actions and design package submission activities shall be included. The Contractor shall include the design schedule in the project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific contract period. This shall be at a detailed level of scheduling sufficient to identify all major design tasks, including those that control the flow of work. The schedule shall include review and correction periods associated with each item.

##### 3.3.2.3. Procurement Activities

The schedule must include activities associated with the submittal, approval, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days. A typical procurement sequence includes the string of activities: submit, approve, procure, fabricate, and deliver.

##### 3.3.2.4. Mandatory Tasks

The following tasks must be included and properly scheduled:

- 3.3.2.4.1. Submission, review and acceptance of design packages
- 3.3.2.4.2. Submission of mechanical/electrical/information systems layout drawings
- 3.3.2.4.3. Submission and approval of O & M manuals
- 3.3.2.4.4. Submission and approval of as-built drawings
- 3.3.2.4.5. Submission and approval of 1354 data and installed equipment lists



- 3.3.2.4.6. Submission and approval of testing and air balance (TAB)
- 3.3.2.4.7. Submission of TAB specialist design review report
- 3.3.2.4.8. Submission and approval of fire protection specialist
- 3.3.2.4.9. Submission and approval of testing and balancing of HVAC plus commissioning plans and data. Develop the schedule logic associated with testing and commissioning of mechanical systems to a level of detail consistent with Engineering and Construction Bulletin (ECB) No. 2005-10 dated 31 August 2005.
- 3.3.2.4.10. Air and water balancing
- 3.3.2.4.11. HVAC commissioning
- 3.3.2.4.12. Controls testing plan submission
- 3.3.2.4.13. Controls testing
- 3.3.2.4.14. Performance Verification testing
- 3.3.2.4.15. Other systems testing, if required
- 3.3.2.4.16. Contractor's pre-final inspection
- 3.3.2.4.17. Correction of punch list from Contractor's pre-final inspection
- 3.3.2.4.18. Government's pre-final inspection
- 3.3.2.4.19. Correction of punch list from Government's pre-final inspection
- 3.3.2.4.20. Final Inspection

#### 3.3.2.5. Activity Responsibility Coding (RESP)

Assign Responsibility Code for all activities to the Prime Contractor, Subcontractor or Government agency responsible for performing the activity. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements. Code all activities not coded with a Government Responsibility Code to the Prime Contractor or Subcontractor responsible to perform the work. Activities shall not have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE). Unacceptable code values are abbreviations of the names of subcontractors.

#### 3.3.2.6. Activity Work Area Coding (AREA)

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities shall not have more than one Work Area Code. Not all activities are required to be Work Area coded. A lack of Work Area coding will indicate the activity is not resource or space constrained.

#### 3.3.2.7. Contract Changes/Requests for Equitable Adjustment (REA) Coding (MODF)

Assign Activity code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by Contracting Officer, with a Contract Changes/REA Code. Key all Code values to the Government's modification numbering system.

Any activity or sequence of activities added to the schedule as a result of alleged constructive changes made by the Government may be added to a copy of the current schedule, subject to the approval of the Contracting Officer. Assign Activity codes for these activities with a Contract Changes/REA Code. Key the code values to the Contractor's numbering system. Approval to add these activities does not necessarily mean the Government accepts responsibility and therefore liability for such activities and any associated impacts to the schedule, but rather the Government recognizes such activities are appropriately added to the schedule for the purposes of maintaining a realistic and meaningful schedule. Such activities shall not be Responsibility Coded to the Government unless approved. An activity shall not have more than one Contract Changes/REA Code

#### 3.3.2.8. Contract Line Item (CLIN) Coding (BIDI)

Code all activities to the CLIN on the Contract Line Item Schedule to which the activity belongs. An activity shall not contain more than one CLIN Item Code. CLIN Item code all activities, even when an activity is not cost loaded.

#### 3.3.2.9. Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities, based upon the phase of work in which the activity occurs. Code activities to either a Design Phase or a Construction Phase. Code fast track design and construction phases proposed by the Contractor to allow filtering and organizing the schedule by fast track design and construction packages. If the contract specifies construction phasing with separately defined performance periods, identify a Construction Phase Code to allow filtering and organizing the schedule accordingly. Each activity shall have only one Phase of Work code.

#### 3.3.2.10. Category of Work Coding (CATW)

Assign Category of Work code to all Activities based upon the category of work which the activity belongs. Category of Work Code must include, but is not limited to: Design, Design Submittal, Construction Submittal, Approval, Acceptance, Procurement, Fabrication, Delivery, Weather Sensitive Installation, Non-Weather Sensitive Installation, Start Up, Test, and Turnover. Assign a Category of Work code to each activity. Each activity shall have only one Category of Work Code.

#### 3.3.2.11. Definable Features of Work Coding (FOW1, FOW2, FOW3)

Assign a Definable Feature of Work Code to appropriate activities based on the definable feature of work to which the activity belongs. Definable Feature of Work is defined in Specification Section 01 45 04.00 10, Contractor Quality Control. An activity shall not have more than one Definable Feature of Work Code. Not all activities are required to be Definable Feature of Work Coded.

### 3.3.3. Scheduled Project Completion and Activity Calendars

The schedule interval shall extend from NTP date to the required contract completion date. The contract completion activity (End Project) shall finish based on the required contract duration in the accepted contract proposal, as adjusted for any approved contract time extensions. The first scheduled work period shall be the day after NTP is acknowledged by the Contractor. Schedule activities on a calendar to which the activity logically belongs. Activities may be assigned to a 7 day calendar when the contract assigns calendar day durations for the activity such as a Government Acceptance activity. If the Contractor intends to perform physical work less than seven days per week, schedule the associated activities on a calendar with non-work periods identified including weekends and holidays. Assign the Category of Work Code - Weather Sensitive Installation to those activities that are weather sensitive. Original durations must account for anticipated normal adverse weather. The Government will interpret all work periods not identified as non-work periods on each calendar as meaning the Contractor intends to perform work during those periods.

#### 3.3.3.1. Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. Include as the first activity in the project schedule an activity called "Start Project" or "NTP". The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, with a zero day duration.

#### 3.3.3.2. Schedule Constraints and Open Ended Logic

Constrain completion of the last activity in the schedule by the contract completion date. Schedule calculations shall result in negative float when the calculated early finish date of the last activity is later than the contract completion date. Include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the contract completion date for the project, and with a zero day duration or by using the "project must finish by" date in the scheduling software. The schedule shall have no constrained dates other than those specified in the contract. The use of artificial float constraints such as "zero free float" or "zero total float" are typically prohibited. There shall only be 2 open ended activities: Start Project (or NTP) with no predecessor logic and End Project with no successor logic.

#### 3.3.3.3. Early Project Completion

In the event the Preliminary or Initial project schedule calculates an early completion date of the last activity prior to the contract completion date, the Contractor shall identify those activities that it intends to accelerate and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. The last activity shall have a late finish constraint equal to the contract completion date and the schedule will calculate positive float. The Government will not approve an early completion schedule with zero float on the longest path. The Government is under no obligation to accelerate activities for which it is responsible to support a proposed early contract completion.

#### 3.3.4. Interim Completion Dates

Constrain contractually specified interim completion dates to show negative float when the calculated early finish date of the last activity in that phase is later than the specified interim completion date.

##### 3.3.4.1. Start Phase

Include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

##### 3.3.4.2. End Phase

Include as the last activity for a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the specified completion date for that phase and a zero day duration.

##### 3.3.4.3. Phase "X" Hammock

Include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" hammock activity shall be logically tied to the earliest and latest activities in the phase.

#### 3.3.5. Default Progress Data Disallowed

Do not automatically update Actual Start and Finish dates with default mechanisms that may be included in the scheduling software. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the AS and AF dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's updated schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Disable program features which calculate one of these parameters from the other.

#### 3.3.6. Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Correct out of sequence progress that continues for more than two update cycles by logic revision, as approved by the Contracting Officer.

### 3.3.7. Negative Lags and Start to Finish Relationships

Lag durations contained in the project schedule shall not have a negative value. Do not use Start to Finish relationships (SF).

### 3.3.8. Calculation Mode

Schedule calculations shall retain the logic between predecessors and successors even when the successor activity starts and the predecessor activity has not finished. Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") will not be allowed.

### 3.3.9. Milestones

The schedule must include milestone activities for each significant project event including but not limited to: milestone activities for each fast track design package released for construction; design complete; foundation/substructure construction complete; superstructure construction complete; building dry-in or enclosure complete to allow the initiation of finish activities; permanent power complete; and building systems commissioning complete.

## 3.4. PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data CD, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

### 3.4.1. Preliminary Project Schedule Submission

Submit the Preliminary Project Schedule, defining the Contractor's planned operations for the first 90 calendar days for approval within 15 calendar days after the NTP is acknowledged. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. Detail it for the first 90 calendar days. It may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as previously specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all of the required Plan and Program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, the planned submissions of all early design packages, permitting activities, design review conference activities and other non-construction activities intended to occur within the first 90 calendar days. Schedule any construction activities planned for the first 90 calendar days after NTP. Constrain planned construction activities by Government acceptance of the associated design package(s) and all other specified Program and Plan approvals. Activity code any activities that are summary in nature after the first 90 calendar days with Responsibility Code (RESP) and Feature of Work code (FOW1, FOW2, FOW3)

### 3.4.2. Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 42 calendar days after NTP. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. The Initial Schedule shall be at a reasonable level of detail as determined by the Contracting Officer. The schedule shall include detailed design and permitting activities, including but not limited to identification of individual design packages, design submission, reviews and conferences; permit submissions and any required Government actions; and long lead procurement activities required prior to design completion. The Initial Project Schedule shall include the entire construction sequence and all fast track construction activities, with as much detail as is known at the time but, as a minimum, shall include all construction start and completion milestone activities, and detailed construction activities through the dry-in milestone, including all activity coding and cost loading. Include the remaining construction, including cost loading, but it may be scheduled summary in nature. As the design proceeds and design packages are developed, fully detail the remaining construction activities concurrent with the monthly schedule updating process. Constrain construction activities by Government acceptance of associated designs. When the design is complete, incorporate into the then approved schedule update all remaining detailed construction activities that are planned to occur after the dry-in milestone.

**3.4.3. Design Package Schedule Submission:**

With each design package submitted to the Government, submit a frag-net schedule extracted from the then current Preliminary, Initial or Updated schedule which covers the activities associated with that Design Package including construction, procurement and permitting activities.

**3.4.4. Periodic Schedule Updates**

Based on the result of the meeting specified in PERIODIC SCHEDULE UPDATE MEETINGS, submit periodic schedule updates. These submissions shall enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgment of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made. Update the schedule to include detailed procurement and construction activities as the design progresses, but not later than the submission of the final, un-reviewed design submission for each separate design package. The Contracting Officer may require submission of detailed schedule activities for any distinct construction that is started prior to submission of a final design submission, if such activity is authorized.

**3.4.5. Standard Activity Coding Dictionary**

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used. A template SDEF compatible schedule backup file (sdef.prx) is available on the QCS website: [www.rmssupport.com](http://www.rmssupport.com). The SDEF format is as follows:

Field	Activity Code	Length	Description
1	WRKP	3	Workers per Day
2	RESP	4	Responsible Party (e.g. GC, subcontractor, USACE)
3	AREA	4	Area of Work
4	MODF	6	Modification or REA number
5	BIDI	6	Bid Item (CLIN)
6	PHAS	2	Phase of Work
7	CATW	1	Category of Work
8	FOW1	10	Feature of Work (used up to 10 characters in length)
9	FOW2	10	Feature of Work (used up to 20 characters in length)
10	FOW3	10	Feature of Work (used up to 30 characters in length)

**3.5. SUBMISSION REQUIREMENTS**

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

**3.5.1. Data CD's**

Provide two sets of data CD's containing the project schedule in the backup format. Each CD shall also contain all previous update backup files. File medium shall be CD. Label each CD, indicating the type of schedule (Preliminary, Initial, Update), full contract number, Data Date and file names. Each schedule shall have a unique file name as determined by the Contractor.

#### 3.5.2. Narrative Report

Provide a Narrative Report with the Preliminary, Initial, and each Periodic Update of the project schedule, as the basis of the progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths where the total float is less than or equal to 20 work days, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to communicate to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through its analysis. Identify and explain why any activities that, based their calculated late dates, should have either started or finished during the update period but did not.

#### 3.5.3. Approved Changes Verification

Include only those project schedule changes in the schedule submission that have been previously approved by the Contracting Officer. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

#### 3.5.4. Schedule Reports

The format, filtering, organizing and sorting for each schedule report shall be as directed by the Contracting Officer. Typically reports shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. The following lists typical reports that will be requested. One or all of these reports may be requested for each schedule submission.

##### 3.5.4.1. Activity Report

A list of all activities sorted according to activity number.

##### 3.5.4.2. Logic Report

A list of detailed predecessor and successor activities for every activity in ascending order sorted by activity number.

##### 3.5.4.3. Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

##### 3.5.4.4. Earnings Report by CLIN

A compilation of the Contractor's Total Earnings on the project from the NTP to the data date. This report shall reflect the earnings of specific activities based on the agreements made in the schedule update meeting defined herein. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining progress payments. Group activities by CLIN Item number and sort by activity number. This report shall: sum all activities coded to a particular CLIN and provide a CLIN Item percent earned value; and complete and sum CLIN items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

#### 3.5.5. Network Diagram

The network diagram is required for the Preliminary, Initial and Periodic Updates. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished.

The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

#### 3.5.5.1. Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

#### 3.5.5.2. Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

#### 3.5.5.3. Critical Path

Clearly show the critical path.

#### 3.5.5.4. Banding

Organize activities as directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

#### 3.5.5.5. S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

### 3.6. PERIODIC SCHEDULE UPDATE MEETINGS

Conduct periodic schedule update meetings for the purposes of reviewing the Contractor's proposed out of sequence corrections, determining causes for delay, correcting logic, maintaining schedule accuracy and determining earned value. Meetings shall occur at least monthly within five days of the proposed schedule data date and after the Contractor has updated the schedule with Government concurrence respecting actual start dates, actual finish dates, remaining durations and percent complete for each activity it intend to status. Match the actual start and finish dates with the dates exported, as described in paragraph 3.3.5. Provide a computer with the scheduling software loaded and a projector during the meeting which allows all meeting participants to view the proposed schedule update during the meeting. The meeting and resultant approvable schedule update shall be a condition precedent to a formal submission of the update as described in SUBMISSION REQUIREMENTS and to the submission of an invoice for payment. The meeting will be a working interactive exchange which will allow the Government and the Contractor the opportunity review the updated schedule on a real time and interactive basis. The Contractor's authorized scheduling representative will organize, sort, filter and schedule the update as requested by the Government. The meeting will last no longer than 8 hours. A rough draft of the proposed activity logic corrections and narrative report shall be provided to the Government 48 hours in advance of the meeting. The Contractor's Project Manager and Authorized Scheduler shall attend the meeting with the Authorized Representative of the Contracting Officer.

#### 3.6.1. Update Submission Following Progress Meeting

Submit a complete update of the project schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 working days after the periodic schedule update meeting, reflecting only those changes made during the previous update meeting.

#### 3.6.2. Activity Statusing

Statusing information, including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD) and Percent Complete shall be subject to the approval of the Government prior to the meeting. As a minimum, address the following items on an activity by activity basis during each progress meeting:

##### 3.6.2.1. Actual Start and Finish Dates

Accurately status the AS and/or AF dates for each activity currently in-progress or completed since the last update. The Government may allow an AF date to be assigned with the percent complete less than 100% to account for the value of work remaining but not restraining successor activities. Only assign AS dates when actual progress occurs on an activity.

#### 3.6.2.2. Remaining Duration

Update the estimated RD for all incomplete activities independent of Percent Complete. Remaining durations may exceed the activity OD or may exceed the activity's prior update RD if the Government considers the current OD or RD to be understated based on current progress, insufficient work crews actually manning the job, unrealistic OD or deficiencies that must be corrected that restrain successor activities.

#### 3.6.2.3. Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be statused 100 percent complete. To allow for proper schedule management, cost load the correction of punch list from Government pre-final inspection activity(ies) not less than 1% of the total contract value, which activity(ies) may be statused 100 percent complete upon completion and correction of all punch list work identified during Government pre-final inspection(s).

#### 3.6.2.4. Logic Changes

Specifically identify and discuss all logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to contract provisions. The Government will only approve logic revisions for the purpose of keeping the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.

#### 3.6.2.5. Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule that does not represent the actual or planned prosecution and progress of the work.

### 3.7. REQUESTS FOR TIME EXTENSIONS

In the event the Contractor believes it is entitled to an extension of the contract performance period, completion date, or any interim milestone date, furnish the following for a determination by the Contracting Officer: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by the Government. In response to each Request For Proposal issued by the Government, the Contractor shall submit a schedule impact analysis demonstrating whether or not the change contemplated by the Government impacts the critical path.

#### 3.7.1. Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with its request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information.

Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

#### 3.7.2. Submission Requirements



Submit a justification for each request for a change in the contract completion date of less than 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

3.7.2.1. A list of affected activities, with their associated project schedule activity number.

3.7.2.2. A brief explanation of the causes of the change

3.7.2.3. An analysis of the overall impact of the changes proposed.

3.7.2.4. A sub-network of the affected area

Identify activities impacted in each justification for change by a unique activity code contained in the required data file.

### 3.7.3. Additional Submission Requirements

The Contracting Officer may request an interim update with revised activities for any requested time extension of over 2 weeks. Provide this disk within 4 days of the Contracting Officer's request.

### 3.7.4. If Progress Falls Behind the Approved Project Schedule

3.7.4.1. Should progress fall behind the approved schedule (more than 20 work days of negative float) due to Contractor generated problems, promptly provide a supplemental recovery or completion schedule that illustrates its efforts to regain time to assure a completion by the required contract completion date.

3.7.4.2. The supplemental recovery or completion schedule will not replace the original, approved schedule as the official contract schedule. Continue to update the original, approved schedule on at least a monthly basis. In addition, the Contractor and the Contracting Officer will monitor the supplemental recovery or completion schedule on at least a bi-weekly basis to determine its effect on regaining the rate of progress to assure project completion by the contractually required completion date.

3.7.4.3. Do not artificially improve progress by simply revising the schedule logic, modifying or adding constraints, or shortening future work activity durations. Resource and manpower load the supplemental recovery schedule or completion schedule with crew size and productivity for each remaining activity, indicating overtime, weekend work, and/or double shifts needed to regain the schedule, in accordance with FAR 52.236.15, without additional cost to the Government. Indicate assumptions made and the basis for any logic, constraint, or duration changes used in the creation of the supplemental recovery or completion schedule in a narrative submitted for the Contracting Officer's approval. Any additional resources or manpower must be evident at the work site. Do not modify the official contract schedule to include these assumptions.

3.7.4.4. Failure to perform work and maintain progress in accordance with the supplemental recovery or completion schedule may result in an interim and final unsatisfactory performance rating and/or may result in corrective action by the Contracting Officer in accordance with FAR 52.236-15.

### 3.8. DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The Contracting Officer will approve proposed revisions to the schedule prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the

Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

### 3.9. WEEKLY PROGRESS MEETINGS

3.9.1. The Government and the Contractor shall meet weekly (or as otherwise mutually agreed to) between the meetings described in paragraph PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. The then current and approved schedule update shall be used for the purposes of this meeting and for the production and review of reports. The Contractor's Project Manager and the Authorized Representative of the Contracting Officer shall attend. The weekly progress meeting will address the status of RFI's, RFP's and Submittals.

3.9.2. Provide a bar chart produced by the scheduling software, organized by Total Float and Sorted by Early Start Date, and a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities schedule to start during the upcoming two weeks, organized by Work Area Code (AREA) and sorted by Early Start Date.

3.9.3. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date (driving activities), are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately. Corrective action includes but is not limited to: increasing the number of work crews; increasing the number of work shifts; increasing the number of hours worked per shift; and determining if Government responsibility coded activities require Government corrective action.

### 3.10. OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

### 3.11. TRANSFER OF SCHEDULE DATA INTO RMS/QCS

The Contractor shall download and upload the schedule data into the Resident Management System (RMS) prior to RMS databases being transferred to the Government and is considered to be additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 - Payments under Fixed-Price Construction Contracts. The receipt of a proper payment request pursuant to FAR 52.232-27 - Prompt Payment for Construction Contracts is contingent upon the Government receiving both acceptable and approvable hard copies and electronic export from QCS of the application for progress payment.

End of Section 01 32 01.00 10

**SECTION 01 33 00**  
**SUBMITTAL PROCEDURES**

**1.0 GENERAL**

- 1.1. DEFINITIONS
- 1.2. NOT USED
- 1.3. SUBMITTAL CLASSIFICATION
- 1.4. APPROVED OR CONCURRED WITH SUBMITTALS
- 1.5. DISAPPROVED SUBMITTALS
- 1.6. WITHHOLDING OF PAYMENT
- 1.7. GENERAL
- 1.8. SUBMITTAL REGISTER
- 1.9. SCHEDULING
- 1.10. TRANSMITTAL FORM (ENG FORM 4025)
- 1.11. SUBMITTAL PROCEDURES
- 1.12. CONTROL OF SUBMITTALS
- 1.13. GOVERNMENT APPROVED SUBMITTALS
- 1.14. INFORMATION ONLY SUBMITTALS
- 1.15. STAMPS

## 1.0 GENERAL

### 1.1. DEFINITIONS

#### 1.1.1. Submittal

Contract Clauses "FAR 52.236-5, Material and Workmanship," paragraph (b) and "FAR 52.236-21, Specifications and Drawings for Construction," paragraphs (d), (e), and (f) apply to all "submittals."

#### 1.1.2. Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by SD numbers and titles as follows.

##### SD-01 Preconstruction Submittals

- Certificates of insurance.
- Surety bonds.
- List of proposed subcontractors.
- List of proposed products.
- Construction Progress Schedule.
- Submittal register.
- Schedule of prices.
- Accident Prevention Plan.
- Work plan.
- Quality control plan.
- Environmental protection plan.

##### SD-02 Shop Drawings

- Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.
- Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.
- Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

##### SD-03 Product Data

- Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.
- Samples of warranty language when the contract requires extended product warranties.

##### SD-04 Samples

- Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.
- Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.
- Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies that are to be incorporated into the project and those which will be removed at conclusion of the work.

##### SD-05 Design Data

- Calculations, mix designs, analyses or other data pertaining to a part of work.
- Design submittals, design substantiation submittals and extensions of design submittals.

##### SD-06 Test Reports

- Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must

have been within three years of date of contract award for the project.)

- Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.
- Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.
- Investigation reports.
- Daily checklists.
- Final acceptance test and operational test procedure.

#### SD-07 Certificates

- Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.
- Document required of Contractor, or of a supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.
- Confined space entry permits.
- Text of posted operating instructions.

#### SD-08 Manufacturer's Instructions

- Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

#### SD-09 Manufacturer's Field Reports

- Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- Factory test reports.

#### SD-10 Operation and Maintenance Data

- Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

#### SD-11 Closeout Submittals

- Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

##### 1.1.3. Approving Authority

Office authorized to approve submittal.

##### 1.1.4. Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

##### 1.2. NOT USED

##### 1.3. SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

##### 1.3.1. Designer of Record Approved (DA)

1.3.1.1. Designer of Record (DOR) approval is required for all extensions of design, critical materials, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings". Provide the Government the number of copies designated hereinafter of all DOR approved submittals, after the DOR has taken appropriate action. The DOR shall ensure that submittals conform to the Solicitation, the Accepted Proposal and the completed design, however see below for those submittals proposing a deviation to the contract or a substitution of a material, system, or piece of equipment that was identified by manufacturer, brand name or model description in the accepted contract proposal.

1.3.1.2. The DOR shall ensure that the submittals comply with all applicable Buy American Act and Trade Agreement Act clauses in the contract. The DOR may confer with the Contracting Officer's Representative for advice and interpretation of those clauses, as necessary.

1.3.1.3. The Government may, but is not required to, review any or all DOR approved submittals for conformance to the solicitation, accepted proposal and the completed design. Except for submittals designated as deviating from the Solicitation, the Accepted Proposal or completed design, the Contractor may proceed with acquisition and installation upon DOR approval. Government Approved (GA)

#### 1.3.2. Government Approved (GA)

Government approval is required for any item specifically designated as requiring Government approval in the Solicitation, for internal and external color finish selections and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

#### 1.3.3. Government Conformance Review of Design (CR)

The Government will review all intermediate and final design submittals for conformance with the technical requirements of the solicitation. Section 01 33 16 **DESIGN AFTER AWARD** covers the design submittal and review process in detail. Review will be only for conformance with the applicable codes, standards and contract requirements. Design data includes the design documents described in Section 01 33 16 **DESIGN AFTER AWARD**. Generally, design submittals should be identified as SD-05 Design Data submittals.

#### 1.3.4. Designer of Record Approved/Government Conformance Review (DA/CR)

1.3.4.1. Deviations to the Accepted Design. Designer of Record approval and the Government's concurrence are required for any proposed deviation from the accepted design which still complies with the contract (the Solicitation and Accepted Proposal) before the Contractor is authorized to proceed with material acquisition or installation. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings." If necessary to facilitate the project schedule, the Contractor and the DOR may discuss a submittal proposing a deviation with the Contracting Officer's Representative prior to officially submitting it to the Government. However, the Government reserves the right to review the submittal before providing an opinion, if it deems it necessary. In any case, the Government will not formally agree to or provide a preliminary opinion on any deviation without the DOR's approval or recommended approval. The Government reserves the right to non-concur with any deviation from the design, which may impact furniture, furnishings, equipment selections or operations decisions that were made, based on the reviewed and concurred design.

1.3.4.2. Substitutions. Unless prohibited or provided for otherwise elsewhere in the Contract, where the accepted contract proposal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, and the Contractor desires to substitute manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, identifying information and the DOR's approval, as meeting the contract requirements and that it is equal in function, performance, quality and salient features to that in the accepted contract proposal.

#### 1.3.5. Designer of Record Approved/Government Approved (DA/GA)

Any proposed deviation to the solicitation and/or the accepted proposal constitutes a change to the contract. In addition to the above stated requirements for proposed deviations to the accepted design, both Designer of Record and Government Approval and, where applicable, a contract modification are required before the Contractor is

authorized to proceed with material acquisition or installation for any proposed deviation to the contract. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings". The Government reserves the right to accept or reject any such proposed deviation at its discretion.

#### 1.3.6. Information Only

All submittals not requiring Designer of Record or Government approval will be for information only. Provide the Government "For Information Only" copies of all submittals not requiring Government approval or concurrence, after the Designer of Record has taken the appropriate action.

#### 1.4. APPROVED OR CONCURRED WITH SUBMITTALS

Do not construe the Contracting Officer's approval of or concurrence with submittals as a complete check, but only that design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal. Approval or concurrence will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for design, dimensions, all design extensions, such as the design of adequate connections and details, etc., and the satisfactory construction of all work. The Government won't consider re-submittals for the purpose of substituting previously approved materials or equipment unless accompanied by an explanation of why a substitution is necessary.

#### 1.5. DISAPPROVED SUBMITTALS

Make all corrections required by the Contracting Officer, obtain the Designer of Record's approval when applicable, and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. Resubmit any "information only" submittal found to contain errors or unapproved deviations from the Solicitation or Accepted Proposal as one requiring "approval" action, requiring both Designer of Record and Government approval. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, provide prompt notice in accordance with the Contract Clause "Changes" to the Contracting Officer.

#### 1.6. WITHHOLDING OF PAYMENT

No payment for materials incorporated in the work will be made if all required Designer of Record or required Government approvals have not been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

#### 1.7. GENERAL

Make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, the Contractor's Quality Control (CQC) System Manager and the Designer of Record, if applicable, shall check, approve, sign, and stamp all items, indicating action taken. Clearly identify proposed deviations from the contract requirements. Include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Schedule and make submittals requiring Government approval prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples remaining upon completion of the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

#### 1.8. SUBMITTAL REGISTER (GA)

Develop a complete list of submittals, including each separate design package submittal. Submit the initial submittal register within 15 days after Notice to Proceed, including, as a minimum, the design packages and other initial submittals required elsewhere in the contract. The Designer of Record shall identify required submittals in the

specifications, and use the list to prepare the Submittal Register, utilizing the government-provided software, QCS (see Section 01 45 01.10), to create the ENG Form 4288. Appendix Ris a preliminary submittal register input form for use with the Quality Management System and the Resident Office Management System (QCS and RMS). The Government will provide the Contractor the actual Excel Spreadsheet version of this sample input form after award to modify and to use for input into QCS. The Excel Spreadsheet is not totally inputable into QCS, so additional keystroke input will be necessary. The sample input form is not all-inclusive. In addition, additional submittals may be required by other parts of the contract. After award, the parties will meet to discuss contract specific (or task order specific for a task order contract) distribution for the submittals all-inclusive and additional submittals may be required by other parts of the contract. Develop and complete the submittal register as the design is completed. Submit it to the Contracting Officer with the un-reviewed final design package submission or as soon as the design specifications are completed, if before the final design submission. When applicable, if the Contractor elects to fast track design and construction, using multiple design package submissions, update the submittal register to reflect the submittals associated with each design submission, clearly denoting all revisions to the previous submission. The submittal register serves as a scheduling document for submittals and for control of submittal actions throughout the contract period. Coordinate the submit dates and need dates used in the submittal register with dates in the Contractor prepared progress schedule. Submit monthly updates to the submittal register showing the Contractor action codes and actual dates with Government action codes and actual dates or until all submittals have been satisfactorily completed. Revise and submit the submittal register when revising the progress schedule.

#### 1.9. SCHEDULING

Schedule submittals covering component items forming a system or items that are interrelated to be coordinated and submitted concurrently. Schedule certifications to be submitted with the pertinent drawings. Allow adequate time (a minimum of 15 calendar days exclusive of mailing time) and show on the register for those items requiring Government approval or concurrence. No delay damages or time extensions will be allowed for time lost in late submittals by the Contractor.

#### 1.10. TRANSMITTAL FORM (ENG FORM 4025)

Use the transmittal form (ENG Form 4025) for submitting submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor or are included in the QCS software if the Contractor is required to use QCS for this contract. Use a separate transmittal form for each specification section. Complete this form by filling out all the heading blank spaces and identify each item submitted. Exercise special care to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

#### 1.11. SUBMITTAL PROCEDURES

Make submittals as follows:

##### 1.11.1. Procedures

The Government will further discuss detailed submittal procedures with the Contractor at the Post-Award Conference.

##### 1.11.2. Deviations

For submittals which include proposed deviations requested by the Contractor, check the column "variation" of ENG Form 4025. Set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

#### 1.12. CONTROL OF SUBMITTALS

Carefully control his procurement operations to ensure that each individual submittal is made on or before the scheduled submittal date shown on the approved "Submittal Register."

#### 1.13. GOVERNMENT APPROVED OR CONCURRED WITH SUBMITTALS



Upon completion of review of submittals requiring Government approval or concurrence, the Government will stamp and date the submittals as approved or concurred.. The Government will retain three (3) copies of the submittal and return three (3) copy(ies) of the submittal.

#### 1.14. INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe. The Government will retain zero(0) copies of information only submittals.

#### 1.15. STAMPS

Use stamps similar to the following on the submittal data to certify that the submittal meets contract requirements:

CONTRACTOR

(FIRM NAME)

Approved

Approved with corrections as noted on submittal data and/or attached  
sheet(s)

Signature:

Title:

Date:

**For design-build construction, both the Contractor Quality Control System Manager and the Designer of Record shall stamp and sign to certify that the submittal meets contract requirements.**

**SECTION 01 33 16  
DESIGN AFTER AWARD****1.0 GENERAL INFORMATION**

1.1. INTRODUCTION

1.2. DESIGNER OF RECORD

**2.0 PRODUCTS (Not Applicable)****3.0 EXECUTION**

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3.7. FINAL DESIGN REQUIREMENTS

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3.9.1. Submittal Distribution and Quantities

3.9.2. Web based Design Submittals

3.9.3. Mailing of Design Submittals

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**ATTACHMENT A STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS**

**ATTACHMENT B FURNITURE, FIXTURES AND EQUIPMENT REQUIREMENTS**

**ATTACHMENT C TRACKING COMMENTS IN DRCHECKS**

**ATTACHMENT D SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW**

**ATTACHMENT E LEED SUBMITTALS**

**ATTACHMENT F BUILDING INFORMATION MODELING REQUIREMENTS**

**ATTACHMENT G DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT**

## **1.0 GENERAL INFORMATION**

### **1.1. INTRODUCTION**

1.1.1. The information contained in this section applies to the design required after award. After award, the Contractor will develop the accepted proposal into the completed design, as described herein.

1.1.2. The Contractor may elect to fast track the design and construction that is, proceed with construction of parts of the sitework and facilities prior to completion of the overall design. To facilitate fast tracking, the Contractor may elect to divide the design into no more than ten (10) design packages per major facility type and no more than three (3) design packages for site and associated work. Designate how it will package the design, consistent with its overall plan for permitting (where applicable) and construction of the project. See Sections 01 33 00 SUBMITTAL PROCEDURES and 01 32 01.00 10 PROJECT SCHEDULE for requirements for identifying and scheduling the design packaging plan in the submittal register and project schedule. See also Sections 01 10 00 STATEMENT OF WORK and 01 57 20.00 10 ENVIRONMENTAL PROTECTION for any specified permit requirements. If early procurement of long-lead item construction materials or installed equipment, prior to completion of the associated design package, is necessary to facilitate the project schedule, also identify those long-lead items and how it will assure design integrity of the associated design package to meet the contract requirements (The Contract consists of the Solicitation requirements and the accepted proposal). Once the Government is satisfied that the long-lead items meet the contract requirements, the Contracting Officer will allow the Contractor to procure the items at its own risk.

1.1.3. The Contractor may proceed with the construction work included in a separate design package after the Government has reviewed the final (100%) design submission for that package, review comments have been addressed and resolved to the Government's satisfaction and the Contracting Officer (or the Administrative Contracting Officer) has agreed that the design package may be released for construction.

1.1.4. **INTEGRATED DESIGN.** To the maximum extent permitted for this project, use a collaborative, integrated design process for all stages of project delivery with comprehensive performance goals for siting, energy, water, materials and indoor environmental quality and ensures incorporation of these goals. Consider all stages of the building lifecycle, including deconstruction.

### **1.2. DESIGNER OF RECORD**

Identify, for approval, the Designer of Record ("DOR") that will be responsible for each area of design. One DOR may be responsible for more than one area. Listed, Professional Registered, DOR(s) shall account for all areas of design disciplines shall be accounted for by a listed. The DOR's shall stamp, sign, and date each design drawing and other design deliverables under their responsible discipline at each design submittal stage (see contract clause Registration of Designers). If the deliverables are not ready for release for construction, identify them as "preliminary" or "not for release for construction" or by using some other appropriate designation. The DOR(s) shall also be responsible for maintaining the integrity of the design and for compliance with the contract requirements through construction and documentation of the as-built condition by coordination, review and approval of extensions of design, material, equipment and other construction submittals, review and approval or disapproval of requested deviations to the accepted design or to the contract, coordination with the Government of the above activities, and by performing other typical professional designer responsibilities.

## **2.0 PRODUCTS (Not Applicable)**

## **3.0 EXECUTION**

### **3.1. PRE-WORK ACTIVITIES & CONFERENCES**

#### **3.1.1. Design Quality Control Plan**

Submit for Government acceptance, a Design Quality Control Plan in accordance with Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL before design may proceed.

#### **3.1.2. Post Award Conference**

3.1.2.1. The government will conduct a post award contract administration conference at the project site, as soon as possible after contract award. This will be coordinated with issuance of the contract notice to proceed (NTP). The Contractor and major sub-contractor representatives shall participate. All designers need not attend this first meeting. Government representatives will include COE project delivery team members, facility users, facility command representatives, and installation representatives. The Government will provide an agenda, meeting goals, meeting place, and meeting time to participants prior to the meeting.

3.1.2.2. The post award conference shall include determination and introduction of contact persons, their authorities, contract administration requirements, discussion of expected project progress processes, and coordination of subsequent meetings for quality control (see Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL), Partnering (see below and SCR: Partnering), and the initial design conference (see below).

3.1.2.3. The government will introduce COE project delivery team members, facility users, facility command representatives, and installation representatives. The DB Contractor shall introduce major subcontractors, and other needed staff. Expectations and duties of each person shall be defined for all participants. A meeting roster shall be developed and distributed by the government with complete contact information including name, office, project role, phone, mailing and physical address, and email address.

### 3.1.3. Partnering & Project Progress Processes

3.1.3.1. The initial Partnering conference may be scheduled and conducted at any time with or following the post award conference. The Government proposes to form a partnership with the DB Contractor to develop a cohesive building team. This partnership will involve the COE project delivery team members, facility users, facility command representatives, installation representatives, Designers of Record, major subcontractors, contractor quality control staff, and contractor construction management staff. This partnership will strive to develop a cooperative management team drawing on the strengths of each team member in an effort to achieve a quality project within budget and on schedule. This partnership will be bilateral in membership and participation will be totally voluntary. All costs, excluding labor and travel expenses, shall be shared equally between the Government and the Contractor. The Contractor and Government shall be responsible for their own labor and travel costs. Normally, partnering meetings will be held at or in the vicinity of the project installation.

3.1.3.2. As part of the partnering process, the Government and Contractor shall develop, establish, and agree to comprehensive design development processes including conduct of conferences, expectations of design development at conferences, fast-tracking, design acceptance, Structural Interior Design (SID)/ Furniture, Fixtures & Equipment (FF&E) design approval, project closeout, etc. The government will explain contract requirements and the DB Contractor shall review their proposed project schedule and suggest ways to streamline processes.

### 3.1.4. Initial Design Conference

The initial design conference may be scheduled and conducted at the project installation any time after the post award conference, although it is recommended that the partnering process be initiated with or before the initial design conference. Any design work conducted after award and prior to this conference should be limited to site and is discouraged for other items. All Designers of Record shall participate in the conference. The purpose of the meeting is to introduce everyone and to make sure any needs the contractor has are assigned and due dates established as well as who will get the information. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning the BIM Implementation Plan demonstration at this meeting. The DB Contractor shall conduct the initial design conference.

### 3.1.5. Pre-Construction Conference

Before starting construction activities, the Contractor and Government will jointly conduct a pre-construction administrative conference to discuss any outstanding requirements and to review local installation requirements for start of construction. It is possible there will be multiple Pre-Construction Conferences based on the content of the design packages selected by the Contractor. The Government will provide minutes of this meeting to all participants.

## 3.2. STAGES OF DESIGN SUBMITTALS AND OVER THE SHOULDER PROGRESS REVIEWS

The stages of design submittals described below define Government expectations with respect to process and content. The Contractor shall determine how to best plan and execute the design and review process for this project, within the parameters listed below. As a minimum, the Government expects to see at least one interim design submittal, at least one final design submittal before construction of a design package may proceed and at least one Design Complete submittal that documents the accepted design. The Contractor may sub-divide the design into separate packages for each stage of design and may proceed with construction of a package after the Government accepts the final design for that package. See discussion on waivers to submission of one or more intermediate design packages where the parties partner during the design process. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning BIM and the various stages of design submittals and over-the-shoulder progress reviews.

### 3.2.1. Site/Utilities

To facilitate fast-track design-construction activities the contractor may submit a final (100%) site and utility design as the first design submittal or it may elect to submit interim and final site and utility design submittals as explained below. Following review, resolution, and incorporation of all Government comments, and submittal of a satisfactory set of site/utility design documents, after completing all other pre-construction requirements in this contract and after the pre-construction meeting, the Government will allow the Contractor to proceed with site development activities, including demolition where applicable, within the parameters set forth in the accepted design submittal. For the first site and utility design submission, whether an interim or final, the submittal review, comment, and resolution times from this specification apply, except that the Contractor shall allow the Government a 14 calendar day review period, exclusive of mailing time. No on-site construction activities shall begin prior to written Government clearance to proceed.

### 3.2.2. Interim Design Submittals

The Contractor may submit either a single interim design for review, representing a complete package with all design disciplines, or split the interim design into smaller, individual design packages as it deems necessary for fast-track construction purposes. As required in Section 01 32 01.00 10 PROJECT SCHEDULE, the Contractor shall schedule its design and construction packaging plan to meet the contract completion period. This submission is the Government's primary opportunity to review the design for conformance to the solicitation and to the accepted contract proposal and to the Building Codes at a point where required revisions may be still made, while minimizing lost design effort to keep the design on track with the contract requirements. The requirements for the interim design review submittals and review conferences are described hereinafter. This is not necessarily a hold point for the design process; the Contractor may designate the interim design submittal(s) as a snapshot and proceed with design development at its own risk. See below for a waiver, where the parties establish an effective over-the-shoulder progress review procedure through the partnering process that would eliminate the need for or expedite a formal intermediate design review on one or more individual design packages.

### 3.2.3. Over-the-Shoulder Progress Reviews

To facilitate a streamlined design-build process, the Government and the Contractor may agree to one-on-one reviewer or small group reviews, electronically, on-line (if available within the Contractor's standard design practices) or at the Contractor's design offices or other agreed location, when practicable to the parties. The Government and Contractor will coordinate such reviews to minimize or eliminate disruptions to the design process. Any data required for these reviews shall normally be provided in electronic format, rather than in hard copy. If the Government and Contractor establish and implement an effective, mutually agreeable partnering procedure for regular (e.g., weekly) over-the-shoulder review procedures that allow the Government reviewers the opportunity to keep fully informed of the progress, contents, design intent, design documentation, etc. of the design package, the Government will agree to waive or to expedite the formal intermediate design review period for that package. The Contractor shall still be required to submit the required intermediate design documentation, however the parties may agree to how that material will be provided, in lieu of a formal consolidated submission of the package. It should be noted that Government funding is extremely limited for non-local travel by design reviewers, so the maximum use of virtual teaming methods must be used. Some possible examples include electronic file sharing, interactive software with on-line or telephonic conferencing, televideo conferencing, etc. The Government must still perform its Code and Contract conformance reviews, so the Contractor is encouraged to partner with the reviewers to find ways to facilitate this process and to facilitate meeting or bettering the design-build schedule. The Contractor shall maintain a fully functional configuration management system as described herein to track design revisions, regardless of whether or not there is a need for a formal intermediate design review. The formal intermediate

review procedures shall form the contractual basis for the official schedule, in the event that the partnering process determines that the formal intermediate review process to be best suited for efficient project execution. However, the Government pledges to support and promote the partnering process to work with the Contractor to find ways to better the design schedule.

#### 3.2.4. Final Design Submissions

This submittal is required for each design package prior to Government acceptance of that design package for construction. The requirements for the final design submittal review conferences and the Government's acceptance for start of construction are described herein after.

#### 3.2.5. Design Complete Submittals

After the final design submission and review conference for a design package, revise the design package to incorporate the comments generated and resolved in the final review conferences, perform and document a back-check review and submit the final, design complete documents, which shall represent released for construction documents. The requirements for the design complete submittals are described hereinafter.

#### 3.2.6. Holiday Periods for Government Review or Actions

Do not schedule meetings, Government reviews or responses during the last two weeks of December or other designated Government Holidays (including Friday after Thanksgiving). Exclude such dates and periods from any durations specified herein for Government actions.

#### 3.2.7. Late Submittals and Reviews

If the Contractor cannot meet its scheduled submittal date for a design package, it must revise the proposed submittal date and notify the government in writing, at least one (1) week prior to the submittal, in order to accommodate the Government reviewers' other scheduled activities. If a design submittal is over one (1) day late in accordance with the latest revised design schedule, or if notification of a proposed design schedule change is less than seven (7) days from the anticipated design submission receipt date, the Government review period may be extended up to seven (7) days due to reviewers' schedule conflicts. If the Government is late in meeting its review commitment and the delay increases the Contractor's cost or delays completion of the project, the Suspension of Work and Defaults clauses provide the respective remedy or relief for the delay.

### 3.3. DESIGN CONFIGURATION MANAGEMENT

#### 3.3.1. Procedures

Develop and maintain effective, acceptable design configuration management (DCM) procedures to control and track all revisions to the design documents after the Interim Design Submission through submission of the As-Built documents. During the design process, this will facilitate and help streamline the design and review schedule. After the final design is accepted, this process provides control of and documents revisions to the accepted design (See Special Contract Requirement: Deviating From the Accepted Design). The system shall include appropriate authorities and concurrences to authorize revisions, including documentation as to why the revision must be made. The DCM data shall be available to the Government reviewers at all times. The Contractor may use its own internal system with interactive Government concurrences, where necessary or may use the Government's "DrChecks Design Review and Checking System" (see below and Attachment C).

#### 3.3.2. Tracking Design Review Comments

Although the Contractor may use its own internal system for overall design configuration management, the Government and the Contractor shall use the DrChecks Design Review and Checking System to initiate, respond to, resolve and track Government design compliance review comments. This system may be useful for other data which needs to be interactive or otherwise available for shared use and retrieval. See Attachment C for details on how to establish an account and set-up the DrChecks system for use on the project.

#### 3.3.3. Design and Code Checklists



Develop and complete various discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists with each design submittal, as applicable, as part of the project documentation. See Section 01 45 04.00 10 Contractor Quality Control, Attachment D for a Sample Fire Protection and Life Safety Code review checklist and Attachment E for LEED SUBMITTALS.

### 3.4. INTERIM DESIGN REVIEWS AND CONFERENCES

#### 3.4.1. General

At least one interim design submittal, review and review conference is required for each design package (except that, per paragraph 3.2.1, the Contractor may skip the interim design submission and proceed directly to final design on the sitework and utilities package). The DB Contractor may include additional interim design conferences or over-the-shoulder reviews, as needed, to assure continued government concurrence with the design work. Include the interim submittal review periods and conferences in the project schedule and indicate what part of the design work is at what percentage of completion. The required interim design conferences shall be held when interim design requirements are reached as described below. See also Paragraph: **Over-the-Shoulder Progress Reviews** for a waiver to the formal interim design review.

#### 3.4.2. Procedures

After receipt of an Interim Design submission, allow the Government fourteen (14) calendar days after receipt of the submission to review and comment on the interim design submittal. For smaller design packages, especially those that involve only one or a few separate design disciplines, the parties may agree on a shorter review period or alternative review methods (e.g., over-the-shoulder or electronic file sharing), through the partnering process. For each interim design review submittal, the COR will furnish, to the Contractor, a single consolidated, validated listing of all comments from the various design sections and from other concerned agencies involved in the review process using the DrChecks Design Review and Checking System. The review will be for conformance with the technical requirements of the solicitation and the Contractor's RFP proposal. If the Contractor disagrees technically with any comment or comments and does not intend to comply with the comment, he/she must clearly outline, with ample justification, the reasons for noncompliance within five (5) days after receipt of these comments in order that the comment can be resolved. Furnish disposition of all comments, in writing, through DrChecks. The Contractor is cautioned that if it believes the action required by any comment exceeds the requirements of this contract, that it should take no action and notify the COR in writing immediately. The Interim Review conference will be held for each design submittal at the installation. Bring the personnel that developed the design submittal to the review conference. The conference will take place the week after the receipt of the comments by the Contractor. For smaller fast-track packages that involve only a few reviewers, the parties may agree to alternative conferencing methods, such as teleconferencing, or televideo, where available, as determined through Partnering.

#### 3.4.3. Conference Documentation

3.4.3.1. In order to facilitate and accelerate the Government code and contract conformance reviews, identify, track resolution of and maintain all comments and action items generated during the design process and make this available to the designers and reviewers prior to the Interim and subsequent design reviews.

3.4.3.2. The DB Contractor shall prepare meeting minutes and enter final resolution of all comments into DrChecks. Copies of comments, annotated with comment action agreed on, will be made available to all parties before the conference adjourns. Unresolved problems will be resolved by immediate follow-on action at the end of conferences. Incorporate valid comments. The Government reserves the right to reject design document submittals if comments are significant. Participants shall determine if any comments are critical enough to require further design development prior to government concurrence. Participants shall also determine how to proceed in order to obtain government concurrence with the design work presented.

### 3.5. INTERIM DESIGN REQUIREMENTS

Interim design deliverables shall include drawings, specifications, and design analysis for the part of design that the Contractor considers ready for review.

#### 3.5.1. Drawings

Include comments from any previous design conferences incorporated into the documents to provide an interim design for the "part" submitted.

### 3.5.2. Design Analyses

3.5.2.1. The designers of record shall prepare and present design analyses with calculations necessary to substantiate and support all design documents submitted. Address design substantiation required by the applicable codes and references and pay particular attention to the following listed items:

3.5.2.2. For parts including sitework, include site specific civil calculations.

3.5.2.3. For parts including structural work, include structural calculations.

- (a) Identify all loads to be used for design.
- (b) Describe the method of providing lateral stability for the structural system to meet seismic and wind load requirements. Include sufficient calculations to verify the adequacy of the method.
- (c) Provide calculations for all principal roof, floor, and foundation members and bracing and secondary members.
- (d) Provide complete seismic analyses for all building structural, mechanical, electrical, architectural, and building features as dictated by the seismic zone for which the facility is being constructed.
- (e) Computer generated calculations must identify the program name, source, and version. Provide input data, including loads, loading diagrams, node diagrams, and adequate documentation to illustrate the design. The schematic models used for input must show, as a minimum, nodes/joints, element/members, materials/properties, and all loadings, induced settlements/deflections, etc., and a list of load combinations. Include an output listing for maximum/minimum stresses/forces and deflections for each element and the reactions for each loading case and combination.
- (f) See also the Security (Anti-Terrorism) requirements below for members subject to Anti-Terrorist Force Protection (ATFP) and Progressive Collapse requirements.
- (g) Fully coordinate and integrate the overall structural design between two different or interfacing construction types, such as modular and stick-built or multistory, stacked modular construction. Provide substantiation of structural, consolidation/settlement analysis, etc., as applicable, through the interfaces.

3.5.2.4. For Security (Anti-Terrorism): Provide a design narrative and calculations where applicable, demonstrating compliance with each of the 22 standards in UFC 4-010-01, which includes Design of Buildings to Resist Progressive Collapse (use the most recent version of UFC 4-023-03, regardless of references to any specific version in UFC 4-010-01). Where sufficient standoff distance is not being provided, show calculations for blast resistance of the structural system and building envelope. Show complete calculations for members subjected to ATFP loads, e.g., support members of glazed items (jambes, headers, sills) connections of windows to support members and connections of support members to the rest of the structure. For 3 story and higher buildings, provide calculations to demonstrate compliance with progressive collapse requirements.

3.5.2.5. For parts including architectural work, include building floor area analysis.

3.5.2.6. For parts including mechanical work, include HVAC analysis and calculations. Include complete design calculations for mechanical systems. Include computations for sizing equipment, compressed air systems, air duct design, and U-factors for ceilings, roofs and exterior walls and floors. Contractor shall employ commercially available energy analysis techniques to determine the energy performance of all passive systems and features. Use of hourly energy load computer simulation is required (see paragraph 3.5.5.2 for list of acceptable software). Based on the results of calculations, provide a complete list of the materials and equipment proposed with the manufacturer's published cataloged product installation specifications and roughing-in data.

3.5.2.7. For parts including life safety, include building code analysis and sprinkler and other suppression systems. Notwithstanding the requirements of the Codes, address the following:

- (a) A registered fire protection engineer (FPE) must perform all fire protection analyses. Provide the fire protection engineer's qualifications. See Section 01 10 00, paragraph 5 for qualifications.

- (b) Provide all references used in the design including Government design documents and industry standards used to generate the fire protection analysis.
- (c) Provide classification of each building in accordance with fire zone, building floor areas and height and number of stories.
- (d) Provide discussion and description of required fire protection requirements including extinguishing equipment, detection equipment, alarm equipment and water supply. Alarm and detection equipment shall interface to requirements of Electronic Systems.
- (e) Provide hydraulic calculations based on water flow test for each sprinkler system to insure that flow and pressure requirements can be met with current water supply. Include copies of Contractor's water flow testing done to certify the available water source.

3.5.2.8. For parts including plumbing systems:

- (a) List all references used in the design.
- (b) Provide justification and brief description of the types of plumbing fixtures, piping materials and equipment proposed for use.
- (c) Detail calculations for systems such as sizing of domestic hot water heater and piping; natural gas piping; LP gas piping and tanks, fuel oil piping and tanks, etc., as applicable.
- (d) When the geotechnical report indicates expansive soils are present, indicate in the first piping design submittal how piping systems will be protected against damage or backfall/backflow due to soil heave (from penetration of slab to the 5 foot building line).

3.5.2.9. For elevator systems:

- (a) List all criteria codes, documents and design conditions used.
- (b) List any required permits and registrations for construction of items of special mechanical systems and equipment.

3.5.2.10. For parts including electrical work, include lighting calculations to determine maintained foot-candle levels, electrical load analysis and calculations, electrical short circuit and protective device coordination analysis and calculations and arc fault calculations.

3.5.2.11. For parts including telecommunications voice/data (including SIPRNET, where applicable), include analysis for determining the number and placement of outlets

3.5.2.12. For Cathodic Protection Systems, provide the following stamped report by the licensed corrosion engineer or NACE specialist with the first design submission. The designer must be qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. He/she must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection Specialist, or must be a registered professional engineer with a minimum of five years experience in corrosion control and cathodic protection. Clearly describe structures, systems or components in soil or water to be protected. Describe methods proposed for protection of each.

3.5.3. Geotechnical Investigations and Reports:

3.5.3.1. The contractor's licensed geotechnical engineer shall prepare a final geotechnical evaluation report, to be submitted along with the first foundation design submittal. Make this information available as early as possible during the over-the-shoulder progress review process. Summarize the subsurface conditions and provide recommendations for the design of appropriate utilities, foundations, floor slabs, retaining walls, embankments, and pavements. Include compaction requirements for fill and backfill under buildings, sidewalks, other structures and open areas. Recommend foundation systems to be used, allowable bearing pressures for footings, lateral load resistance capacities for foundation systems, elevations for footings, grade beams, slabs, etc. Provide an assessment of post-construction settlement potential including total and differential. Provide recommendations regarding lateral earth pressures (active, at-rest, passive) to be used in the design of retaining walls. Include the recommended spectral accelerations and Site Class for seismic design along with an evaluation of any seismic hazards and recommendations for mitigation, if required. Include calculations to support the recommendations for bearing capacity, settlement, and pavement sections. Include supporting documentation for all recommended

design parameters such as Site Class, shear strength, earth pressure coefficients, friction factors, subgrade modulus, California Bearing Ratio (CBR), etc. Provide earthwork recommendations, expected frost penetration, expected groundwater levels, recommendations for dewatering and groundwater control and the possible presence of any surface or subsurface features that may affect the construction of the project such as sinkholes, boulders, shallow rock, old fill, old structures, soft areas, or unusual soil conditions. Include pH tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. Include the raw field data. Arrange a meeting with the Government subsequent to completion and evaluation of the site specific geotechnical exploration to outline any differences encountered that are inconsistent with the Government provided preliminary soils information. Clearly outline differences which require changes in the foundation type, or pavement and earthwork requirements from that possible and contemplated using the Government furnished preliminary soils investigation, which result in a change to the design or construction. Any equitable adjustment is subject to the provisions of the contract's Differing Site Conditions Clause.

3.5.3.2. Vehicle Pavements: The Contractor's geotechnical report shall contain flexible and rigid pavement designs, as applicable for the project, including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades and pavement layers. Provide Information on the types of base course materials available in the area and design strengths.

3.5.3.3. The Contractor and the professional geotechnical engineer consultant shall certify in writing that the design of the project has been developed consistent with the Contractor's final geotechnical report. The certification shall be stamped by the consulting professional geotechnical engineer and shall be submitted with the first design submission. If revisions are made to the initial design submission, a new certification shall be provided with the final design submission.

#### 3.5.4. LEED Documentation:

Assign a LEED Accredited Professional, responsible to track LEED planning, performance and documentation for each LEED credit through construction closeout. Incorporate LEED credits in the plans, specifications and design analyses. Develop LEED supporting documentation as a separable portion of the Design Analysis and provide with each required design submittal. Include the LEED Project checklist for each non-exempt facility (one checklist may be provided for multiple facilities in accordance with the LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects and the LEED SUBMITTALS (Attachment E, herein) with each submittal. Final design submittal for each portion of the work must include all required design documentation relating to that portion of work (example - all site credit design documents with final site design). Submittal requirements are as indicated in Attachment E, LEED SUBMITTALS. Submit all documentation indicated on Attachment E as due at final design at final design submittal (for fast-track projects with multiple final design submittals, this shall be at the last scheduled final design submittal). All project documentation related to LEED shall conform to USGBC requirements for both content and format, including audit requirements and be separate from other design analyses. Maintain and update the LEED documentation throughout project progress to construction closeout and shall compile product data, receipts, calculations and other data necessary to substantiate and support all credits claimed. The Government may audit any or all individual credits. Audit documentation is not required to be submitted unless requested. These requirements apply to all projects. If the project requires the Contractor to obtain USGBC certification, the Contractor shall also be responsible for obtaining USGBC certification and shall provide written evidence of certification with the construction closeout LEED documentation submittal. Install the USGBC building plaque at the location indicated by the Government upon receipt. If Contractor obtains USGBC interim design review, submit the USGBC review to the Government within 30 days of receipt for information only.

3.5.4.1. LEED Documentation for Technology Solution Set. If the Solicitation provides a Prescriptive Technology Solution Set, use of the Technology Solution set has no effect on LEED documentation requirements. Provide all required LEED documentation, including energy analysis, in accordance with LEED requirements when using the Technology Solution Set.

#### 3.5.5. Energy Conservation:

3.5.5.1. Refer to Section 01 10 00, Paragraph 5. Interim and Final Design submittals shall demonstrate that each building including the building envelope, HVAC systems, service water heating, power, and lighting systems meet the Mandatory Provisions and the Prescriptive Path requirements of ASHRAE 90.1. Use Compliance Documentation forms available from ASHRAE and included in the ASHRAE 90.1 User's Manual for this purpose. The Architectural Section of the Design Analysis shall include completed forms titled "Building Envelope

Compliance Documentation Parts I and II". The Heating Ventilating and Air Conditioning (HVAC) Section of the Design Analysis shall include a completed form titled "HVAC Simplified Approach Option - Part I" if this approach is allowed by the Standard. Otherwise, the HVAC Section of the Design Analysis shall include completed forms titled "HVAC Mandatory Provisions - Part II" and "HVAC Prescriptive Requirements - Part III". The Plumbing Section of the Design Analysis shall include a completed form titled "Service Water Heating Compliance Documentation". The Electrical Section of the Design Analysis shall include an explanatory statement on how the requirements of ASHRAE 90.1-2004 Chapter 8 Power were met. The Electrical Section of the Design Analysis shall also include a completed form titled "Lighting Compliance Documentation".

3.5.5.2. Interim and Final Design submittals which address energy consuming systems, (heating, cooling, service hot water, lighting, power, etc.) must also include calculations in a separate Energy Conservation Section of the Design Analysis which demonstrate and document (a) the baseline energy consumption for the facility or facilities under contract, that would meet the requirements of ANSI/ASHRAE/IESNA Standard 90.1 and (b) the energy consumption of the facility or facilities under contract utilizing the materials and methods required by this construction contract. Use the USGBC Energy and Atmosphere (EA) Credit 1 compliance template / form or an equivalently detailed form for documenting compliance with the energy reduction requirements. This template / form is titled PERFORMANCE RATING METHOD and is available when the project is registered for LEED. The calculation methodology used for this documentation and analysis shall follow the guidelines set forth in Appendix G of ASHRAE 90.1, with two exceptions: a) receptacle and process loads may be omitted from the calculation; and b) the definition of the terms in the formula for Percentage Improvement found in paragraph G1.2 are modified as follows: Baseline Building Performance shall mean the annual energy consumption calculated for a building design intended for use as a baseline for rating above standard design meeting the minimum requirements of the energy standard, and Proposed Building Performance shall mean annual energy consumption calculated for the proposed building design intended for construction. This calculation shall address all energy consuming systems in a single integrated methodology. Include laboratory fume hoods and kitchen ventilation loads in the energy calculation. They are not considered process loads. Individual calculations for heating, cooling, power, lighting, power, etc. systems will not be acceptable. The following building simulation software is acceptable for use in calculating building energy consumption: Hourly Analysis Program (HAP) by Carrier Corp., TRACE 700 by Trane Corp., DOE-2 by US Department of Energy, EnergyPlus by DOD/DOE.

### 3.5.6. Specifications

Specifications may be any one of the major, well known master guide specification sources (use only one source) such as MASTERSPEC from the American Institute of Architects, SPECTEXT from Construction Specification Institute or Unified Facility Guide Specifications (UFGS using MASTERFORMAT 2004 numbering system), etc. (including specifications from these sources). Manufacturers' product specifications, utilizing CSI's Manu-Spec, three part format may be used in conjunction with the selected specifications. The designers of record shall edit and expand the appropriate Specifications to insure that all project design requirements, current code requirements, and regulatory requirements are met. Specifications shall clearly identify, where appropriate, specific products chosen to meet the contract requirements (i.e., manufacturers' brand names and model numbers or similar product information).

### 3.5.7. Building Rendering

Present and provide a draft color computer, artist, or hand drawn rendering with the conceptual design submittal of the building exterior. Perspective renderings shall include a slightly overhead view of the entire building to encompass elevations and the roof configuration of the building. After Government review and acceptance, provide a final rendering, including the following:

Three (3) 18" x 24" color prints, framed and matted behind glass with project title underneath the print.

One (1) Image file (high resolution) in JPG format on CD for those in the submittal distribution list.

### 3.5.8. Interim Building Design Contents

The following list represents what the Government considers should be included in the overall completed design for a facility or project. It is not intended to limit the contractor from providing different or additional information as needed to support the design presented, including the require design analyses discussed above. As the Contractor develops individual design packages and submits them for Interim review, include as much of the applicable

information for an individual design package as is developed at the Interim design level for review purposes. These pieces shall be developed as the design progresses toward the design complete stage.

#### 3.5.8.1. Lawn and Landscaping Irrigation System

#### 3.5.8.2. Landscape, Planting and Turfing

#### 3.5.8.3. Architectural

- (a) Design Narrative
- (b) Architectural Floor Plans, Typical Wall and Roof Sections, Elevations
- (c) Finish schedule
- (d) All required equipment
- (e) Special graphics requirements
- (f) Door and Window Schedules
- (g) Hardware sets using BHMA designations
- (h) Composite floor plan showing all pre-wired workstations
- (i) Structural Interior Design (SID) package: See ATTACHMENT A for specific requirements
- (j) Furniture, Fixtures & Equipment (FF&E) design package: See ATTACHMENT B for specific requirements

#### 3.5.8.4. Structural Systems. Include:

- (a) Drawings showing principal members for roof and floor framing plans as applicable
- (b) Foundation plan showing main foundation elements where applicable
- (c) Typical sections for roof, floor, and foundation conditions

#### 3.5.8.5. Plumbing Systems

- (a) Show locations and general arrangement of plumbing fixtures and major equipment
- (b) Plan and isometric riser diagrams of all areas including hot water, cold water, waste and vent piping. Include natural gas (and meter as required), (natural gas and meter as required), (LP gas), (fuel oil) and other specialty systems as applicable.
- (c) Include equipment and fixture connection schedules with descriptions, capacities, locations, connection sizes and other information as required

#### 3.5.8.6. HVAC Systems

- (a) Mechanical Floor Plans: The floor plans shall show all principle architectural features of the building which will affect the mechanical design. The floor plans shall also show the following:
  - (1) Room designations.
  - (2) Mechanical legend and applicable notes.
  - (3) Location and size of all ductwork and piping.
  - (4) Location and capacity of all terminal units (i.e., registers, diffusers, grilles, hydronic baseboards).
  - (5) Pre-Fabricated Paint Spray Booth (where applicable to project scope)
  - (6) Paint Preparation Area (where applicable to project scope)
  - (7) Exhaust fans and specialized exhaust systems.
  - (8) Thermostat location.
  - (9) Location of heating/cooling plant (i.e., boiler, chiller, cooling tower, etc).
  - (10) Location of all air handling equipment.

- (11) Air balancing information.
- (12) Flue size and location.
- (13) Piping diagram for forced hot water system (if used).
- (b) Equipment Schedule: Provide complete equipment schedules. Include:
  - (1) Capacity
  - (2) Electrical characteristics
  - (3) Efficiency (if applicable)
  - (4) Manufacturer's name
  - (5) Optional features to be provided
  - (6) Physical size
  - (7) Minimum maintenance clearances
- (a) Details: Provide construction details, sections, elevations, etc., only where required for clarification of methods and materials of design.
- (b) HVAC Controls: Submit complete HVAC controls equipment schedules, sequences of operation, wiring and logic diagrams, Input/Output Tables, equipment schedules, and all associated information. See the Statement of Work for additional specific requirements.

#### 3.5.8.7. Fire Protection and Life Safety.

- (a) Provide plan for each floor of each building that presents a compendium of the total fire protection features being incorporated into the design. Include the following types of information:
  - (1) The location and rating of any fire-resistive construction such as occupancy separations, area separations, exterior walls, shaft enclosures, corridors, stair enclosures, exit passageways, etc.
  - (2) The location and coverage of any fire detection systems
  - (3) The location and coverage of any fire suppression systems (sprinkler risers, standpipes, etc.)
  - (4) The location of any other major fire protection equipment
  - (5) Indicate any hazardous areas and their classification
  - (6) Schedule describing the internal systems with the following information: fire hazard and occupancy classifications, building construction type, GPM/square foot sprinkler density, area of operation and other as required
- (b) Working plans and all other materials submitted shall meet NFPA 13 requirements, with respect to required minimum level of detail.

#### 3.5.8.8. Elevators. Provide:

- (a) Description of the proposed control system
- (b) Description, approximate capacity and location of any special mechanical equipment for elevators.

#### 3.5.8.9. Electrical Systems.

- (a) Electrical Floor Plan(s): Show all principle architectural features of the building which will affect the electrical design. Show the following:
  - (1) Room designations.
  - (2) Electrical legend and applicable notes.
  - (3) Lighting fixtures, properly identified.
  - (4) Switches for control of lighting.
  - (5) Receptacles.

- (6) Location and designation of panelboards. Clearly indicate type of mounting required (flush or surface) and reflect accordingly in specifications.
- (7) Service entrance (conduit and main disconnect).
- (8) Location, designation and rating of motors and/or equipment which requires electrical service. Show method of termination and/or connection to motors and/or equipment. Show necessary junction boxes, disconnects, controllers (approximate only), conduit stubs, and receptacles required to serve the motor and/or equipment.
- (b) Building Riser Diagram(s) (from pad-mounted transformer to unit load center panelboard): Indicate the types and sizes of electrical equipment and wiring. Include grounding and metering requirements.
- (c) Load Center Panelboard Schedule(s): Indicate the following information:
  - (1) Panelboard Characteristics (Panel Designation, Voltage, Phase, Wires, Main Breaker Rating and Mounting.
  - (2) Branch Circuit Designations.
  - (3) Load Designations.
  - (4) Circuit Breaker Characteristics. (Number of Poles, Trip Rating, AIC Rating)
  - (5) Branch Circuit Connected Loads (AMPS).
  - (6) Special Features
- (d) Lighting Fixture Schedule(s): Indicate the following information:
  - (1) Fixture Designation.
  - (2) General Fixture Description.
  - (3) Number and Type of Lamp(s).
  - (4) Type of Mounting.
  - (5) Special Features.
- (e) Details: Provide construction details, sections, elevations, etc. only where required for clarification of methods and materials of design.

3.5.8.10. Electronic Systems including the following responsibilities:

- (a) Fire Detection and Alarm System. Design shall include layout drawings for all devices and a riser diagram showing the control panel, annunciator panel, all zones, radio transmitter and interfaces to other systems (HVAC, sprinkler, etc.)
- (b) Fire Suppression System Control. Specify all components of the Fire Suppression (FS) System in the FS section of the specifications. Clearly describe how the system will operate and interact with other systems such as the fire alarm system. Include a riser diagram on the drawings showing principal components and interconnections with other systems. Include FS system components on drawing legend. Designate all components shown on floor plans "FS system components" (as opposed to "Fire Alarm components"). Show location of FS control panels, HVAC control devices, sensors, and 120V power panel connections on floor plans. Indicate zoning of areas by numbers (1, 2, 3) and detectors sub-zoned for cross zoning by letter designations (A and B). Differentiate between ceiling mounted and under floor detectors with distinct symbols and indicate sub-zone of each.
- (c) Public Address System
- (d) Special Grounding Systems. Completely reflect all design requirements in the specifications and drawings. Specifications shall require field tests (in the construction phase), witnessed by the Government, to determine the effectiveness of the grounding system. Include drawings showing existing construction, if any.
- (e) Cathodic Protection.
- (f) Intrusion Detection, Card Access System
- (g) Central Control and Monitoring System
- (h) Mass Notification System
- (i) Electrical Power Distribution Systems



3.5.8.11. Separate detailed Telecommunications drawings for Information Systems including the following responsibilities:

- (a) Telecommunications Cabling
- (b) Supporting Infrastructure
- (a) Outside Plant (OSP) Cabling - Campus or Site Plans - Exterior Pathways and Inter-Building Backbones
  - (a) Include a layout of the voice/data outlets (including voice only wall & pay phones) on telecommunication floor plan drawing, location of SIPRNET data outlets (where applicable), and a legend and symbol definition to indicate height above finished floor. Show size of conduit and cable type and size on Riser Diagram. Do not show conduit runs between backboard and outlets on the floor plans. Show underground distribution conduit and cable with sizing from point of presence to entrance facility of building.
  - (b) Layout of complete building per floor - Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways including Serving Zones Drawings - Drop Locations and Cable ID's
  - (c) Communication Equipment Rooms - Plan Views - Tech and AMEP/Elevations - Racks and Walls. Elevations with a detailed look at all telecomm rooms. Indicate technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevation and backboard elevation. They may also be an enlargement of a congested area of T1 or T2 series drawing.

### 3.6. FINAL DESIGN REVIEWS AND CONFERENCES

A final design review and review conference will be held upon completion of final design at the project installation, or – where equipment is available - by video teleconference or a combination thereof, for any design package to receive Government acceptance to allow release of the design package for construction. For smaller separate design packages, the parties may agree on alternative reviews and conferences (e.g., conference calls and electronic file sharing, etc.) through the Partnering process. Include the final design conference in the project schedule and shall indicate what part of the design work is at 100% completion. The final design conference will be held after the Government has had seven (7) calendar days after receipt of the submission to review the final design package and supporting data. For smaller packages, especially those involving only one or a few design disciplines the parties may agree on a shorter period.

### 3.7. FINAL DESIGN REQUIREMENTS

Final design deliverables for a design package shall consist of 100% complete drawings, specifications, submittal register and design analyses for Government review and acceptance. The 100% design submission shall consist of drawings, specifications, updated design analyses and any permits required by the contract for each package submitted. In order to expedite the final design review, prior to the conference, ensure that the design configuration management data and all review comment resolutions are up-to-date. Include the 100% SID and 100% FF&E binders for government approval. The Contractor shall have performed independent technical reviews (ITR's) and back-checks of previous comment resolutions, as required by Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL, including providing documentation thereof.

#### 3.7.1. Drawings

3.7.1.1. Submit drawings complete with all contract requirements incorporated into the documents to provide a 100% design for each package submitted.

3.7.1.2. Prepare all drawings with the Computer-Aided Design and Drafting (CADD)/Computer-Aided Design (CAD) system, organized and easily referenced electronically, presenting complete construction information.

3.7.1.3. Drawings shall be complete. The Contractor is encouraged to utilize graphics, views, notes, and details which make the drawings easier to review or to construct but is also encouraged to keep such materials to those that are necessary.

3.7.1.4. Provide detail drawings that illustrate conformance with the contract. Include room finish schedules, corresponding color/finish/special items schedules, and exterior finish schedules that agree with the submitted SID binders.

3.7.1.5. The design documents shall be in compliance with the latest version of the A/E/C CADD Standard, available at <https://caddbim.usace.army.mil/CAD>. Use the approved vertical Corps of Engineers title blocks and borders on all drawings with the appropriate firm name included within the title block area.

3.7.1.6. CAD System and Building Information Modeling (BIM) (NOTE: If this is a Single Award or Multiple Award, Indefinite Delivery/Indefinite Quantity Contract, this information will be provided for each task order.)

All CAD files shall be fully compatible with AutoCAD 2000 or higher. Save all design CAD files as AutoCAD 2000 or higher files. All submitted BIM Models and associated Facility Data shall be fully compatible with Autodesk Revit 9.0 or higher file formats.

(a) CAD Data Final File Format: During the design development capture geo-referenced coordinates of all changes made to the existing site (facility footprint, utility line installations and alterations, roads, parking areas, etc) as a result of this contract. There is no mandatory methodology for how the geo-referenced coordinates will be captured, however, Engineering and Construction Bulletin No. 2006-15, Subject: Standardizing Computer Aided Design (CAD) and Geographic Information Systems (GIS) Deliverables for all Military Design and Construction Projects identifies the format for final as-built drawings and data sets to be delivered to the government. Close-out requirements at the as-built stage; require final geo-referenced GIS Database of the new facility along with all exterior modifications. The Government will incorporate this data set into the Installation's GIS Masterplan or Enterprise GIS System. See also, Section 01 78 02.00 10 Closeout Submittals.

(b) Electronic Drawing Files: In addition to the native CAD design files, provide separate electronic drawing files (in editable CAD format and Adobe Acrobat PDF version 7.0 or higher) for each project drawing.

(c) Each file (both CAD and PDF) shall represent one complete drawing from the drawing set, including the date, submittal phase, and border. Each drawing file shall be completely independent of any data in any other file, including fonts and shapes not included with the basic CAD software program utilized. Drawing files with external references or special fonts are not acceptable. All displayed graphic elements on all levels of the drawing files shall be part of the project drawing image. The drawing files shall not contain any graphic element that is not part of the drawing image.

(d) Deliver BIM Model and associated Facility Data files in their native format. At a minimum, BIM files shall address major architecture design elements, major structural components, mechanical systems and electrical/communication distribution and elements as defined in Attachment F. See Attachment F for additional BIM requirements.

(e) Drawing Index: Provide an index of drawings sheet in CAD as part of the drawing set, and an electronic list in Microsoft Excel of all drawings on the CD. Include the electronic file name, the sheet reference number, the sheet number, and the sheet title, containing the data for each drawing.

(f) Hard Copies: Plot submitted hard copy drawings directly from the "electronic drawing files" and copy for quantities and sizes indicated in the distribution list at the end of this specification section. The Designers of Record shall stamp, sign and date original hard copy sheets as Released For Construction, and provide copies for distribution from this set.

### 3.7.2. Design Analyses

3.7.2.1. The designers of record shall update, finalize and present design analyses with calculations necessary to substantiate and support all design documents submitted.

3.7.2.2. The responsible DOR shall stamp, sign and date the design analysis. Identify the software used where, applicable (name, version, vendor). Generally, provide design analyses, individually, in an original (file copy) and one copy for the assigned government reviewer.

3.7.2.3. All disciplines review the LEED design analysis in conjunction with their discipline-specific design analysis; include a copy of the separable LEED design analysis in all design analysis submittals.

3.7.2.4. Do not combine multi-disciplined volumes of design-analysis, unless multiple copies are provided to facilitate multiple reviewers (one copy per each separate design analysis included in a volume).

### 3.7.3. Specifications

Specifications shall be 100% complete and in final form.

#### 3.7.4. Submittal Register

Prepare and update the Submittal Register and submit it with the 100% design specifications (see Specification Section 01 33 00, SUBMITTAL PROCEDURES) with each design package. Include the required submittals for each specification section in a design package in the submittal register.

#### 3.7.5. Preparation of DD Form 1354 (Transfer of Real Property)

This form itemizes the types, quantities and costs of various equipment and systems that comprise the project, for the purpose of transferring the new construction project from the Corps Construction Division to the Installation's inventory of real property. The Government will furnish the DB Contractor's design manager a DD Form 1354 checklist to use to produce a draft Form 1354. Submit the completed checklist and prepared draft Form DD 1354 with the 100% design in the Design Analysis. The Corps will use these documents to complete the final DD 1354 upon completion of construction.

#### 3.7.6. Acceptance and Release for Construction

3.7.6.1. At the conclusion of the Final Design Review (after resolutions to the comments have been agreed upon between DOR and Government reviewers), the Contracting Officer or the ACO will accept the Final Design Submission for the design package in writing and allow construction to start for that design package. The Government may withhold acceptance until all major corrections have been made or if the final design submission requires so many corrections, even though minor, that it isn't considered acceptably complete.

3.7.6.2. Government review and acceptance of design submittals is for contract conformance only and shall not relieve the Contractor from responsibility to fully adhere to the requirements of the contract, including the Contractor's accepted contract proposal, or limit the Contractor's responsibility of design as prescribed under Special Contract Requirement: "Responsibility of the Contractor for Design" or limit the Government's rights under the terms of the contract. The Government reserves the right to rescind inadvertent acceptance of design submittals containing contract deviations not separately and expressly identified in the submittal for Government consideration and approval.

### 3.8. DESIGN COMPLETE CONSTRUCTION DOCUMENT REQUIREMENTS

After the Final Design Submission and Review Conference and after Government acceptance of the Final Design submission, revise the design documents for the design package to incorporate the comments generated and resolved in the final review conference, perform and document a back-check review and submit the final, design complete documents. Label the final design complete documents "FOR CONSTRUCTION" or use similar language. In addition to the final drawings and specifications, the following deliverables are required for distribution and field use. The deliverable includes all documentation and supporting design analysis in final form, as well as the final review comments, disposition and the back-check. As part of the quality assurance process, the Government may perform a back-check of the released for construction documentation. Promptly correct any errors or omissions found during the Government back-check. The Government may withhold retainage from progress payments for work or materials associated with a final design package until this submittal has been received and the Government determines that it is complete.

### 3.9. SUBMITTAL DISTRIBUTION, MEDIA AND QUANTITIES

#### 3.9.1. Submittal Distribution and Quantities

General: The documents which the Contractor shall submit to the Government for each submittal are listed and generally described in preceding paragraphs in this Section. Provide copies of each design submittal and design substantiation as follows (NOTE: If this is a Single Award or Multiple Award, Indefinite Delivery/Indefinite Quantity Contract, this information will be provided for each task order):

Activity and Address	Drawing Size (Full Size) <b>A1</b> Full Sets/ *Partial Sets	Design Analyses & Specs Full Sets/ *Partial Sets	Drawing Size (Half Size) <b>Half Size</b> Full Sets/ *Partial Sets	Non-BIM Data CD-ROM or DVD as Necessary (PDF& <b>.dwg</b> )	Furniture Submittal (FFE)	Structural Interior Design Submittal	BIM Data DVD (Per Attach F)
Commander, U.S.Army Engineer District <b>Norfolk District</b>	1/1	6/6	6/6	1	1	1	2
Commander, U.S.Army Engineer District, Center of Standardization <b>Omaha District</b>	0/0	2/2	2/2	0	0	0	0
Installation	1/1	9/9	9/9	3	2	2	2
U.S.Army Corps of Engineers Construction Area Office	1/1	7/7	5/5	0	1	0	0
Information Systems Engineering Command (ISEC)	0/0	0/0	0/0	1	1 (Electronic only)	N/A	1
Other Offices	30/30	30/30	30/30	30	4	4	30

**\*NOTE: For partial sets of drawings, specifications and design analyses, see paragraph 3.9.3.3, below.**

**\*\*NOTE: When specified below in 3.9.2, furnish Installation copies of Drawings as paper copies, in lieu of the option to provide secure web-based submittals.**

### 3.9.2. Web based Design Submittals

Web based design submittals will be acceptable as an alternative to the paper copies listed in the Table above, provided a single hard-copy PDF based record set is provided to the Contracting Officer for record purposes. Where the contract requires the Contractor to submit documents to permitting authorities, still provide those authorities paper copies (or in an alternate format where required by the authority). Web based design submittal information shall be provided with adequate security and availability to allow unlimited access those specifically authorized to Government reviewers while preventing unauthorized access or modification. File sizes must be of manageable size for reviewers to quickly download or open on their computers. As a minimum, drawings shall be full scale on American National Standards Institute (ANSI) D sheets (34" x 22"). In addition to the optional website, provide the BIM data submission on DVD to each activity and address noted above in paragraph 3.9.1 for each BIM submission required in Attachment F.

### 3.9.3. Mailing of Design Submittals

3.9.3.1. Mail all design submittals to the Government during design and construction, using an overnight mailing service. The Government will furnish the Contractor addresses where each copy shall be mailed to after award of the contract (or individual task order if this is an indefinite delivery/indefinite quantity, task order contract). Mail the submittals to fifteen (15) different addresses. Assemble drawing sheets, specs, design analyses, etc. into individual sets; do not combine duplicate pages from individual sets so that the government has to assemble a set.

3.9.3.2. Each design submittal shall have a transmittal letter accompanying it indicating the date, design percentage, type of submittal, list of items submitted, transmittal number and point of contact with telephone number.

3.9.3.3. Provide partial sets of drawings, specifications, design analyses, etc., as designated in the Table in paragraph 3.9.1, to those reviewers who only need to review their applicable portions of the design, such as the various utilities. The details of which office receives what portion of the design documentation will be worked out after award.

### 3.10. AS-BUILT DOCUMENTS

Provide as-built drawings and specifications in accordance with Section 01 78 02.00 10, CLOSEOUT SUBMITTALS. Update LEED design phase documentation during construction as needed to reflect construction changes and advancing project completion status (example - Commissioning Plan updates during construction phase) and include updated LEED documentation in construction closeout submittal.

## ATTACHMENT A STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS

### 1.0 GENERAL INFORMATION

Structural Interior Design includes all building related elements and components generally part of the building itself, such as wall finishes, ceilings finishes, floor coverings, marker/bulletin boards, blinds, signage and built in casework. Develop the SID in conjunction with the furniture footprint.

### 2.0 STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS

#### 2.1. FORMAT AND SCHEDULE

Prepare and submit for approval an interior and exterior building finishes scheme for an interim design submittal. The DOR shall meet with and discuss the finish schemes with the appropriate Government officials prior to preparation of the schemes to be presented. Present original sets of the schemes to reviewers at an interim design conference.

At the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers, the Contractor may proceed to final design with the interior finishes scheme presented.

The SID information and samples are to be submitted in 8 ½" x 11" format using three ring binders with pockets on the inside of the cover. When there are numerous pages with thick samples, use more than one binder. Large D-ring binders are preferred to O-ring binders. Use page protectors that are strong enough to keep pages from tearing out. Anchor large or heavy samples with mechanical fasteners, Velcro, or double-faced foam tape rather than rubber cement or glue. Fold out items must have a maximum spread of 25 ½". Provide cover and spine inserts sheets identifying the document as "Structural Interior Design" package. Include the project title and location, project number, Contractor/A/E name and phone number(s), submittal stage and date.

Design submittal requirements include, but are not limited to:

#### 2.1.1. Narrative of the Structural Interior Design Objectives

The SID shall include a narrative that discusses the building related finishes. Include topics that relate to base standards, life safety, sustainable design issues, aesthetics, durability and maintainability, discuss the development and features as they relate to the occupants requirements and the building design.

#### 2.1.2. Interior Color Boards

Identify and key each item on the color boards to the contract documents to provide a clear indication of how and where each item will be used. Arrange finish samples to the maximum extent possible by room type in order to illustrate room color coordination. Label all samples on the color boards with the manufacturer's name, patterns and colors name and number. Key or code samples to match key code system used on contract drawings.

Material and finish samples shall indicate true pattern, color and texture. Provide photographs or colored photocopies of materials or fabrics to show large overall patterns in conjunction with actual samples to show the actual colors. Finish samples must be large enough to show a complete pattern or design where practical.

Color boards shall include but not be limited to original color samples of the following:

All walls finishes and ceiling finishes, including corner guards, acrylic wainscoting and wall guards/chair rail finishes

All tile information, including tile grout color and tile patterns.

- All flooring finishes, including patterns.
- All door, door frame finishes and door hardware finishes
- All signage, wall base, toilet partitions, locker finishes and operable/folding partitions and trim

- All millwork materials and finishes (cabinets, counter tops, etc.)
- All window frame finishes and window treatments (sills, blinds, etc.)

Color board samples shall reflect all actual finish textures, patterns and colors required as specified. Patterned samples shall be of sufficient size to adequately show pattern and its repeat if a repeat occurs.

#### 2.1.3. Exterior Color Boards

Prepare exterior finishes color boards in similar format as the interior finishes color boards, for presentation to the reviewers during an interim design conference. Provide original color samples of all exterior finishes including but not limited to the following:

- All Roof Finishes
- All Brick and Cast Stone Samples
- All Exterior Insulation and Finish Samples
- All Glass Color Samples
- All Exterior Metals Finishes
- All Window & Door Frame Finishes
- All Specialty Item Finishes, including trim

Identify each item on the exterior finishes color boards and key to the building elevations to provide a clear indication of how and where each item will be used.

### 2.2. STRUCTURAL INTERIOR DESIGN DOCUMENTS

#### 2.2.1. General

Structural interior design related drawings must indicate the placement of extents of SID material, finishes and colors and must be sufficiently detailed to define all interior work. The following is a list of minimum requirements:

#### 2.2.2. Finish Color Schedule

Provide finish color schedule(s) in the contract documents. Provide a finish code, material type, manufacturer, series, and color designations. Key the finish code to the color board samples and drawings.

#### 2.2.3. Interior Finish Plans

Indicate wall and floor patterns and color placement, material transitions and extents of interior finishes.

#### 2.2.4. Furniture Footprint Plans

Provide furniture footprint plans showing the outline of all freestanding and systems furniture for coordination of all other disciplines.

#### 2.2.5. Interior Signage

Include interior signage plans or schedules showing location and quantities of all interior signage. Key each interior sign to a quantitative list indicating size, quantity of each type and signage text.

#### 2.2.6. Interior Elevations, Sections and Details

Indicate material, color and finish placement.

**ATTACHMENT B**  
**FURNITURE, FIXTURES & EQUIPMENT (FF&E) REQUIREMENTS**

**1.0 FF&E REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS**

**1.1. FORMAT AND SCHEDULE**

Prepare and submit for approval a comprehensive FF&E scheme for an interim design submittal. The Contractor's interior designer, not a furniture dealer, shall develop the design. FF&E is the selection, layout, specification and documentation of furniture includes but is not limited to workstations, seating, tables, storage and shelving, filing, trash receptacles, clocks, framed artwork, artificial plants, and other accessories. Contract documentation is required to facilitate pricing, procurement and installation. The FF&E package is based on the furniture footprint developed in the Structural Interior Design (SID) portion of the interior design. Develop the FF&E package concurrently with the building design to ensure that there is coordination between the electrical outlets, switches, J-boxes, communication outlets and connections, and lighting as appropriate. In addition, coordinate layout with other building features such as architectural elements, thermostats, location of TV's, GF/GI equipment (for example computers, printers, copiers, shredders, faxes), etc. Locate furniture in front of windows only if the top of the item falls below the window and unless otherwise noted, do not attach furniture including furniture systems to the building. If project has SIPRNET and/or NIPRNET, coordinate furniture layout with SIPRNET and NIPRNET separation requirements. Verify that access required by DOIM for SIPRNET box and conduit is provided. The DOR shall interview appropriate Government personnel to determine FF&E requirements for furniture and furnishings prior to preparation of the scheme to be presented. Determine FFE items and quantities by, but not limited to: (1) the number of personnel to occupy the building, (2) job functions and related furniture/office equipment to support the job function, (3) room functions, (4) rank and grade. Present original sets of the scheme to reviewers at an interim design conference upon completion of the interim architectural submittal or three months prior to the submittal of the final FF&E package (whichever comes first).

Design may proceed to final with the FF&E scheme presented at the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers.

Provide six copies of the electronic versions of all documents upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first), to ensure adequate time for furniture acquisition. Provide unbound, electronic drawings in CAD and BIM. Provide all files needed to view complete drawings. Submit all text documents in Microsoft Word or Excel..

Submit three copies of the final and complete FF&E information and samples in 8 ½" x 11" format using three ring binders with pockets on the inside of the cover upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first). Use more than one binder when there are numerous pages with thick samples. Large D-ring binders are preferred to O-ring binders. Use page protectors that are strong enough to keep pages from tearing out for upholstery and finish boards. Anchor large or heavy samples with mechanical fasteners, Velcro, or double-faced foam tape rather than rubber cement or glue. Fold out items must have a maximum spread of 25 ½". Provide cover and spine inserts sheets identifying the document as "Furniture, Fixtures & Equipment" package and include the project title and location, project number, Contractor/A/E name and phone number(s), submittal stage and date.

Provide electronic copies of all documents upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first), to ensure adequate time for furniture acquisition. Provide six compact disks with all drawings files needed to view the complete drawings unbound and in the latest version AutoCAD. Provide six additional compact disks of all text documents in Microsoft Word or Excel.

Design submittal requirements include, but are not limited to:

**1.1.1. Narrative of Interior Design Objectives**

Provide a narrative description of the furniture, to include functional, safety and ergonomic considerations, durability, sustainability, aesthetics, and compatibility with the building design.

**1.1.2. Furniture Order Form**



Prepare one Furnishings Order Form for each item specified in the design. This form identifies all information required to order each individual item. In addition to the project name and location, project number, and submittal phase, the order form must include:

- (a) Furniture item illustration and code
- (b) Furniture item name
- (c) Job name, location, and date
- (d) General Services Administration (GSA) FSC Group, part, and section
- (e) Manufacturer, Product name and Product model number or National Stock Number (NSN)
- (f) Finish name and number (code to finish samples)
- (g) Fabric name and number, minimum Wyzenbeek Abrasion Test double rubs (code to fabric samples)
- (h) Dimensions
- (i) Item location by room number and room name
- (j) Quantity per room
- (k) Total quantity
- (l) Special instructions for procurement ordering and/or installation (if applicable)
- (m) Written Product Description: include a non-proprietary paragraph listing the salient features of the item to include but not limited to:
  - (1) required features and characteristics
  - (2) ergonomic requirements
  - (3) functional requirements
  - (4) testing requirements
  - (5) furniture style
  - (6) construction materials
  - (7) minimum warranty

The following is an example for “m” features and characteristics, ergonomic requirements and functional requirements:

Chair Description:

- (1) Mid-Back Ergonomic Task Chair
- (2) Pneumatic Gaslift; Five Star Base
- (3) Mesh Back; Upholstered Seat
- (4) Height and Width Adjustable Task Arms:
  - a. Arm Height: 6”- 11” (+-1/2”)
  - b. Arm Width: 2”– 4” adjustment
- (5) Height Adjustable Lumbar Support
- (6) Adjustable Seat Height 16”-21” (+- 1”)
- (7) Sliding Seat Depth Adjustment 15”-18” (+-1”)
- (8) Standard Hard Casters (for carpeted areas)
- (9) Overall Measurements:
  - a. Overall width: 25” - 27”
  - b. Overall depth: 25”– 28”

- (10) Must have a minimum of the following adjustments (In addition to the above):
- 360 Degree Swivel
  - Knee-Tilt with Tilt Tension
  - Back angle
  - Forward Tilt
  - Forward Tilt and Upright Tilt Lock

For projects with systems furniture, also provide a written description of the following minimum requirements:

- Type furniture systems (panel, stacking panels, spine wall, desk based system, or a combination)
- Minimum noise reduction coefficient (NRC)
- Minimum sound transfer coefficient (STC)
- Minimum flame spread and smoke development
- UL testing for task lighting and electrical system
- Panel widths and heights and their locations (this may be done on the drawings) Worksurface types and sizes (this may be done on the drawings)
- Worksurface edge type
- Varying panel/cover finish materials and locations (locations may be shown on the drawings)
- Storage requirements
- Keyboard requirements
- Lock and keying requirements
- Accessory components (examples: tack boards, marker boards, paper management)
- Electrical and communication raceway requirement; type, capacity and location (base, beltline, below and/or above beltline)
- Locations of communication cables (base, beltline, below and/or above beltline, top channel)
- Types of electrical outlets
- Types of communication jacks; provided and installed by others
- Locations of electrical outlets and communication jacks (this may be done on the drawings)
- Type of cable (examples: Cat. 5, Cat. 6, fiber optic; UTP or STP, etc.) system needs to support; provided and installed by others

#### 1.1.3. Alternate Manufacturer List

Provide a table consisting of major furniture items that lists the manufacturers products specified on the Order Form and two alternate manufacturers. Major furniture items include, but are not limited to, casegoods, furniture systems, seating, and tables. Organize matrix by item code and item name. Supply alternates that are available on GSA Schedule and meet the requirements of the Furniture Order Form. One of the two alternates must be from UNICOR if possible. Provide manufacturer name address, telephone number, product series and product name for each alternate manufacturer.

#### 1.1.4. FF&E Procurement List

Provide a table that lists all FF&E furniture, mission unique equipment and building Contractor Furnished/Contractor Installed (CF/CI) items. Give each item a code and name and designate whether item will be procured as part of the FF&E furniture, mission unique equipment or the building construction contract. Use the item code to key all FF&E documents including location plans, color boards, data sheets, cost estimate, etc.

#### 1.1.5. Points of Contact (POCs)

Provide a comprehensive list of POCs needed to implement the FF&E package. This would include but not be limited to appropriate project team members, using activity contacts, interior design representatives, construction contractors and installers involved in the project. In addition to name, address, phone, fax and email, include each contact's job function. Divide the FF&E package into different sections based on this listing, applies to order forms and cost estimates.

#### 1.1.6. Color Boards

Provide color boards for all finishes and fabrics for all FF&E items. Finishes to be included but not limited to paint, laminate, wood finish, fabric, etc.

#### 1.1.7. Itemized Furniture Cost Estimate

Provide an itemized cost estimate of furnishings keyed to the plans and specifications of products included in the package. This cost estimate should be based on GSA price schedules. The cost estimate must include separate line items for general contingency, installation, electrical hook-up for systems furniture or other furniture requiring hardwiring by a licensed electrician, freight charges and any other related costs. Installation and freight quotes from vendors should be use in lieu of a percentage allowance when available. Include a written statement that the pricing is based on GSA schedules. An estimate developed by a furniture dealership may be provided as support information for the estimate, but must be separate from the contractor provided estimate.

### 1.2. INTERIOR DESIGN DOCUMENTS

#### 1.2.1. Overall Furniture and Area Plans

Provide floor Plans showing locations and quantities of all freestanding, and workstation furniture proposed for each floor of the building. Key each room to a large scale Furniture Placement Plan showing the furniture configuration, of all furniture. Provide enlarged area plans with a key plan identifying the area in which the building is located. Key all the items on the drawings by furniture item code. Do not provide manufacturer specific information such as product names and numbers on drawings, Drawings shall be non-proprietary. This is typical for FFE on all plans, including those mentioned below.

#### 1.2.2. Workstation Plans

Show each typical workstation configuration in plan view, elevations or isometric view. Drawings shall illustrate panels and all major components for each typical workstation configuration. Identify workstations using the same numbering system as shown on the project drawings. Key components to a legend on each sheet which identifies and describes the components along with dimensions. Provide the plan, elevations and isometric of each typical workstation together on the same drawing sheet.

#### 1.2.3. Panel Plans

Show panel locations and critical dimensions from finished face of walls, columns, panels including clearances and aisle widths. Key panel assemblies to a legend which shall include width, height, configuration of frames, panel fabric and finishes (if there are different selections existing within a project), powered or non-powered panel and wall mount locations.

#### 1.2.4. Desk Plans

Provide typical free standing desk configurations in plan view, elevation or isometric view and identify components to clearly represent each desk configuration.

#### 1.2.5. Reflected Ceiling Plans

Provide typical plans showing ceiling finishes and heights, lighting fixtures, heating ventilation and air conditioning supply and return, and sprinkler head placement for coordination of furniture.

#### 1.2.6. Electrical and Telecommunication Plans

Show power provisions including type and locations of feeder components, activated outlets and other electrical components. Show locations and quantities of outlets for workstations. Clearly identify different outlets, i.e. electrical, LAN and telecommunication receptacles indicating each type proposed. Show wiring configuration, (circuiting, switching, internal and external connections) and provide as applicable.

#### 1.2.7. Artwork Placement Plans

Provide an Artwork Placement Plan to show location of artwork, assign an artwork item code to each piece of artwork. As an alternative, artwork can be located on the Furniture Plans. Provide a schedule that identifies each piece by room name and number. Provide installation instructions; include mounting height.

#### 1.2.8. Window Drapery Plans

Provide Interior Window Drapery Plans. Key each drapery treatment to a schedule showing color, pattern, material, drapery size and type, draw direction, location and quantities.

### 1.3. FURNITURE SELECTION

1.3.1. Select furniture from the GSA Schedules. Specify furniture available open market when an item is not available on the GSA Schedules. Provide justification for items not available on the GSA Schedules.

1.3.2. To the greatest extent possible when specifying furniture work within a manufacturer's family of furniture for selections, example: Steelcase, Turnstone, Brayton International, Metro, and Vecta are all Steelcase companies. Each alternate should also be specified from a manufacturer's family of furniture, example: first set of alternates would be specified from Knoll's family of furniture and the second from Herman Miller family of furniture. It may be necessary to make some selections from other than a manufacturer's family of furniture if costs are not reasonable for particular items, some items are not available or appropriate for the facility or the items are not on GSA Schedule. If this occurs, consider specifying product from an open line that is accessible by numerous dealerships. Select office furniture including case goods, tables, storage, seating, etc. that is compatible in style, finish and color. Select furniture that complies with ANSI/BIFMA and from manufacturer's standard product line as shown in the most recent published price list and/or amendment and not custom product.

### 1.4. CONSTRUCTION

1.4.1. Provide knee space at workstations and tables that is not obstructed by panels/legs that interfere with knee space of seated person and provide desks, storage and tables with leveling devices to compensate for uneven floors.

1.4.2. Provide worksurface tops constructed to prevent warpage. Provide user friendly features such as radius edges. Do not use sharp edges and exposed connections and ensure the underside of desks, tables and worksurfaces are completely and smoothly finished. Provide abutting worksurfaces that mate closely and are of equal heights when used in side-by-side configurations in order to provide a continuous and level worksurface.

1.4.3. Drawers shall stay securely closed when in the closed position and protect wires from damage during drawer operation. Include a safety catch to prevent accidental removal when fully open.

1.4.4. Unless otherwise noted, specify lockable desks and workstations and storage of steel construction. Use tempered glass glazing when glazing is required.

### 1.5. FINISHES AND UPHOLSTERY

1.5.1. Specify neutral colors for casegoods, furniture systems, storage and tables. Specify desk worksurfaces and table tops that are not too light or too dark in color and have a pattern to help hide soiling. Accent colors are allowed in break and lounge areas. Keep placement of furniture systems panel fabric accent colors to a minimum. All finishes shall be cleanable with ordinary household cleaning solutions.

1.5.2. Use manufacturer's standard fabrics; including textile manufacturers fabrics that have been graded into the furniture manufacturers fabric grades and are available through their GSA Schedule. Customers Own Material

(COM) can be used in headquarter buildings in command suites with executive furniture. Coordinate specific locations with Corps of Engineers Interior Designer.

1.5.3. Specify seating upholstery that meets Wyzenbeek Abrasion Test, 55,000 minimum rubs. Specify a soil retardant finish for woven fabrics if Crypton or vinyl upholstery is not provided for seating in dining areas. Use manufacturer's standard fabrics. This includes textile manufacturers fabrics that have been graded into the furniture manufactures fabric grades and are available through their GSA Schedule. Specify upholstery and finish colors and patterns that help hide soiling. Specify finishes that can be cleaned with ordinary household cleaning solutions.

#### 1.6. ACCESSORIES

1.6.1. Specify all accessories required for completely finished furniture installation. Provide filing cabinets and storage for office supplies. Provide tack surfaces at workstations with overhead storage. Provide tackable surfaces at workstations with overhead storage.

1.6.2. Not Used.

1.6.3. Workstations are to be equipped with stable keyboard trays that have height adjustability, tilting capability, including negative tilt, have a mouse pad at same height as the keyboard tray that can accommodate both left and right handed users, and retractable under worksurface.

#### 1.7. MISSION UNIQUE EQUIPMENT

Funding for FF&E furniture items and mission unique equipment (MUE) items are from two different sources. Separate the designs and procurement documentation for FFE items and MUE. MUE includes, but is not limited to, items such as industrial shelving, workbenches, appliances, fitness equipment, IT equipment and supporting carts. The User will purchase and install mission unique equipment items, unless otherwise noted. Identify locations of known MUE items such as industrial shelving, workbenches, appliances, etc. for space planning purposes.

#### 1.8. SUSTAINABILITY

1.8.1. For all designs provided regardless of facility type, make every effort to implement all aspects of sustainability to the greatest extent possible for all the selections made in the FF&E package. This includes but is not limited to the selection of products that consider: **Material Chemistry and Safety of Inputs** (What chemicals are used in the construction of the selections?); **Recyclability** (Do the selections contain recycled content?); **Disassembly** (Can the selections be disassembled at the end of their useful life to recycle their materials?).

1.8.2. Make selections to the greatest extent possible of products that possess current McDonough Braungart Design Chemistry ([MBDC](#)) certification or other "third-party" certified Cradle to Cradle program, Forest Stewardship Council (FSC) certification, GREENGAURD certification or similar "third-party" certified products consisting of low-emitting materials.

#### 1.9. FURNITURE SYSTEMS

1.9.1. General.

Where appropriate, design furniture systems in open office areas. Coordinate style and color of furniture systems with other storage, seating, etc. in open office areas. Minimize the number of workstation typicals and the parts and pieces required for the design to assist in future reconfiguration and inventorying.

1.9.2. Connector Systems.

Specify a connector system that allows removal of a single panel or spine wall within a typical workstation configuration without requiring disassembly of the workstation or removal of adjacent panels. Specify connector system with tight connections and continuous visual seals. When Acoustical panels are used, provide connector system with continuous acoustical seals. Specify concealed clips, screws, and other construction elements, where possible.

1.9.3. Panels and Spine Walls

Specify panels and spine walls with hinged or removable covers that permit easy access to the raceway when required but are securely mounted and cannot be accidentally dislodged under normal conditions. Panels shall be capable of structurally supporting more than 1 fully loaded component per panel per side. Raceways are to be an integral part of the panel and must be able to support lay-in cabling and have a large capacity for electrical and IT. Do not thread cables through the frame.

#### 1.9.4. Electrical And Information/Technology (IT)

Design furniture with electrical systems that meets requirements of UL 1286 when powered panels are required and UL approved task lights that meet requirements of NFPA 70. Dependent on user requirements and Section 01 10 00, paragraph 3 requirements, it is recommended that workstation electrical and IT wiring entry come from the building walls to eliminate the use of power poles and access at the floor. Design electrical and IT systems that are easily accessed in the spine wall and panels without having to move return panels and components. Electrical and IT management will be easily accessible by removable wall covers which can be removed while workstation components are still attached. Specify connector system that has continuation of electrical and IT wiring within workstations and workstation to workstation.

#### 1.9.5. Pedestals

Specify pedestals that are interchangeable from left to right, and right to left, and retain pedestal locking system capability.

### 1.10. EXECUTIVE FURNITURE

1.10.1. Design for executive furniture in command areas, coordinate specific locations with Corps of Engineers Interior Designer. Use upgraded furniture, upholsteries and finishes in command suites. This includes but is not limited to wood casegoods, seating and tables. Select executive furniture casegoods from a single manufacturer and style line, to include workstations, credenzas, filing, and storage, etc.

1.10.2. Specify furniture with wood veneer finish (except worksurfaces) with mitered solid wood edge of same wood type. Provide worksurface plastic laminate that closely matches adjacent wood veneer. Other executive office furniture such as seating, tables, executive conference room furniture, etc. shall be compatible in style, finish and color with executive furniture casegoods.

#### 1.11. SEATING

##### 1.11.1. General

Specify appropriate chair casters and glides for the floor finish where the seating is located. Universal casters that are appropriate for both hard surface flooring and carpet are preferred. All seating shall support up to a minimum of 250 lbs.

##### 1.11.2. Desk and Guest Seating

Select ergonomic desk chairs with casters, non-upholstered adjustable arms, waterfall front, swivel, tilt, variable back lock, adjustable back height or adjustable lumbar support, pneumatic seat height adjustment, and padded, contoured upholstered seat and back. Desk and guest chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Depending on scale of desk chair provide seat pan forward and back adjustment to increase or decrease depth of seat pan. All desk chairs shall have an adjustable seat height range of 4 1/2", range to include 16 1/2"-20". Select guest chairs that are compatible in style, finish and color with the desk chairs.

##### 1.11.3. Conference Room Seating

At tables, select ergonomic conference seating with casters, non-upholstered arms, waterfall front, swivel, tilt, pneumatic seat height adjustment, and padded, contoured seat and back, unless otherwise noted. Select arm height and/or design that allows seating to be moved up closely to the table top. Conference chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Perimeter conference chairs shall be compatible in style, finish and color with conference seating at the tables.

#### 1.11.4. Lounge, Waiting and Reception Area Seating

Select seating with arms and cushioned, upholstered seat and back. In heavy use areas, arms shall be easily cleaned such as non-upholstered arms or upholstered arms with wood arm caps unless otherwise noted.

#### 1.11.5. Break Room Seating

Select stackable seating that is easily cleaned. Seating shall be appropriate for table and counter heights as applicable with non-upholstered arms if arms are required. Chairs shall have metal legs and composite materials for seats.

#### 1.11.6. Lounge, Waiting and Reception Furniture.

Design for end and coffee tables with plastic laminate tops that are compatible in style finish and color with the seating.

#### 1.12. FILING AND STORAGE.

Select storage and shelving units that meet customer's functional load requirements for stored items. Specify counterweights for filing cabinets when required by the manufacturer for stability. File drawers shall allow only one drawer to be opened at a time. Provide heavy duty storage and shelving if information is not available.

#### 1.13. TRAINING TABLES.

Don't use plastic laminate self edge. Training tables shall be reconfigurable, moveable and storable; lighter weight folding with dollies or casters as necessary. Specify dollies if required.

#### 1.14. FURNITURE WARRANTIES.

Specify manufacturer's performance guarantees or warranties that include parts, labor and transportation as follows:

Furniture System, unless otherwise noted – 10 year minimum  
Furniture System Task Lights – 2 year minimum, excluding bulbs  
Furniture System Fabric – 3 year minimum  
Desks - 10 year minimum  
Seating, unless otherwise noted - 10 year minimum  
Seating Mechanisms and Pneumatic Cylinders - 10 years  
Fabric - 3 years minimum  
Filing and Storage - 10 year minimum  
Tables, unless otherwise noted - 10 year minimum  
Table Mechanisms – 5 year  
Table Ganging Device - 1 year  
Items not listed above - 1 year minimum

## **ATTACHMENT C**

### **TRACKING COMMENTS IN DRCHECKS**

#### **1.0 General**

The Government and DB Contractor shall set up the project in Dr Checks. Throughout the design process, the parties shall enter, track, and back-check comments using the DrChecks system. Government reviewers enter design review comments into DrChecks. Designers of Record shall annotate comments timely and specifically to indicate exactly what action will be taken or why the action is not required. Comments considered critical by the conference participants shall be flagged as such.

#### **2.0 DrChecks Review Comments**

The Contractor and the Government shall monitor DrChecks to assure all comments are annotated and agreed to by the designers and reviewers prior to the next submittal. The DrChecks comments and responses shall be printed and included in the design analysis for record.

2.1. Conference participants (reviewers) will expect coordination between Design Analysis calculations and the submitted design. Reviewers will also focus on the design submittal's satisfaction of the contract requirements.

2.2. The Designers of Record shall answer each comment in DrChecks with a formal response prior to the next submittal, clearly indicating what action will be taken and what drawing/spec will change. Designers of Record are encouraged to directly contact reviewers to discuss and agree to the formal comment responses rather than relying only on DrChecks and review meetings to discuss comments. With the next design conference, reviewers will back-check answers to the comments against the submittal, in addition to reviewing additional design work.

2.3. Comments that, in the DB Contractor's opinion, require effort outside the scope of the contract shall be clearly indicated as such in DrChecks. The DB Contractor shall not proceed with work outside the contract until a modification to the contract is properly executed, if one is necessary.

#### **3.0 DrChecks Initial Account Set-Up**

To initialize an office's use of DrChecks, choose a contact person within the office to call the DrChecks Help Desk at 800-428-HELP, M-F, 8AM-5PM, Central time. This POC will be given an office password to distribute to others in the office. Individuals can then go to the hyperlink at <http://www.projnet.org> and register as a first time user. Upon registration, each user will be given a personal password to the DrChecks system.

3.1. Once the office and individuals are registered, the COE's project manager or lead reviewer will assign the individuals and/or offices to the specific project for review. At this point, persons assigned can make comments, annotate comments, and close comments, depending on their particular assignment.

#### **4.0 DrChecks Reviewer Role**

The Contractor is the technical reviewer and the Government is the compliance reviewer of the DB designers design documents. Each reviewer enters their own comments into the Dr Checks system. To enter comments:

4.1. Log into DrChecks.

4.2. Click on the appropriate project.

4.3. Click on the appropriate review conference. An Add comment screen will appear.

4.4. Select or fill out the appropriate sections (particularly comment discipline and type of document for sorting) of the comment form and enter the comment in the space provided.

4.5. Click the Add Comment button. The comment will be added to the database and a fresh screen will appear for the next comment you have.



- 4.6. Once comments are all entered, exit DrChecks by choosing "My Account" and then Logout.

## **5.0 DrChecks Comment Evaluation**

The role of the designers of record is to evaluate and respond to the comments entered by the Government reviewers and by the DB Contractor. To respond to comments:

- 5.1. Log into DrChecks.
- 5.2. Click on the appropriate project.
- 5.3. Under "Evaluate" click on the number under "Pending".
- 5.4. Locate the comments that require your evaluation. (Note: If you know the comment number you can use the Quick Pick window on your home page in DrChecks; enter the number and click on go.)
- 5.5. Select the appropriate evaluation (concur, non-concur, for information only, or check and resolve) and add the response.
- 5.6. Click on the Add button. The evaluation will be added to the database and a fresh screen will appear with the next comment.
- 5.7. Once evaluations are all entered, exit DrChecks by choosing "My Account" and then Logout.

## **6.0 DrChecks Back-check**

At the following design conference, participants will back-check comment annotations against newly presented documents to verify that the designers' responses are acceptable and completed. The Contractor and Government reviewers shall either enter additional back-check comments, as necessary or close those that are resolved as a result of the design conferences:

- 6.1. Log into DrChecks.
- 6.2. Click on the appropriate project.
- 6.3. Under "My Backcheck" click on the number under "Pending".
- 6.4. If you agree with the designer's response select "Close Comment" and add a closing response if desired.
- 6.5. If you do not agree with the designer's response or the submittal does not reflect the response given, select "Issue Open", enter additional information.
- 6.6. Click on the Add button. The back-check will be added to the database and a fresh screen will appear with the next comment.
- 6.7. Once back-checks are all entered, exit DrChecks by choosing "My Account" and then Logout. The design is completed and final when there are no pending comments to be evaluated and there are no pending or open comments under back-check.

**ATTACHMENT D**  
**SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW**

Instructions: Use the information outlined in this document to provide the minimum requirement for development of Fire Protection and Life Safety Code submittals for all building projects. Additional and supplemental information may be used to further develop the code review. Insert N/A after criteria, which may be "not applicable".

**1.0 SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW**

- 1.1. Project Name (insert name and location)
- 1.2. Applicable Codes and Standards
  - 1.2.1. Unified Facilities Criteria (UFC): 3-600-01, Design: Fire Protection Engineering For Facilities
  - 1.2.2. International Building Code (IBC) for fire resistance requirements, allowable floor area, building height limitations and building separation distance requirements, except as modified by UFC 3-600-01.
  - 1.2.3. National Fire Protection Association (NFPA) 101 Life Safety Code (latest edition), for building egress and life safety and applicable criteria in UFC 3-600-01.
  - 1.2.4. ADA and ABA Accessibility Guidelines. For Buildings and Facilities See Section 01 10 00, Paragraph 3 for facility specific criteria.
- 1.3. Occupancy Classification  
IBC chapters 3 and 4
- 1.4. Construction Type  
IBC chapter 6
- 1.5. Area Limitations  
IBC chapter 5, table 503
- 1.6. Allowable Floor Areas  
IBC section 503, 505
- 1.7. Allowable area increases  
IBC section 506, 507
- 1.8. Maximum Height of Buildings  
IBC section 504
- 1.9. Fire-resistive substitution
- 1.10. Occupancy Separations  
IBC table 302.3.2
- 1.11. Fire Resistive Requirements
  - 1.11.1. Exterior Walls - [ ] hour rating, IBC table 601, 602
  - 1.11.2. Interior Bearing walls - [ ] hour rating
  - 1.11.3. Structural frame - [ ] hour rating
  - 1.11.4. Permanent partitions - [ ] hour rating

- 1.11.5. Shaft enclosures - [ ] hour rating
- 1.11.6. Floors & Floor-Ceilings - [ ] hour rating
- 1.11.7. Roofs and Roof Ceilings - [ ] hour rating
- 1.12. Automatic Sprinklers and others used to determine the need for automatic Extinguishing Equipment, Extinguishing Systems, Foam Systems, Standpipe
  - 1.12.1. UFC 3-600-01, chapters 4 and 6 systems, wet chemical systems, etc. State which systems are required and to what criteria they will be designed.
  - 1.12.2. UFC 3-600-01, Appendix B Occupancy Classification. Note the classification for each room. This may be accomplished by classifying the entire building and noting exceptions for rooms that differ (E.g. The entire building is Light Hazard except boiler room and storage rooms which are [ ], etc.)
  - 1.12.3. UFC 3-600-01, Chapter 3 Sprinkler Design Density, Sprinkler Design Area, Water Demand for Hose Streams (supply pressure and source requirements).
  - 1.12.4. UFC 3-600-01, Chapter 4 Coverage per sprinkler head. Extended coverage sprinkler heads are not permitted.
  - 1.12.5. Available Water Supply. Provide the results of the water flow tests showing the available water supply static pressure and residual pressure at flow. Based on this data and the estimated flow and pressure required for the sprinkler system, determine the need for a fire pump.
  - 1.12.6. NFPA 13, Para. 8.16.4.6.1. Provide backflow preventer valves as required by the local municipality, authority, or water purveyor. Provide a test valve located downstream of the backflow preventer for flow testing the backflow preventer at full system demand flow. Route the discharge to an appropriate location outside the building.
- 1.13. Kitchen Cooking Exhaust Equipment  
Describe when kitchen cooking exhaust equipment is provided for the project. Type of extinguishing systems for the equipment should be provided. per NFPA 96. Show all interlocks with manual release switches, fuel shutoff valves, electrical shunt trips, exhaust fans, and building alarms.
- 1.14. Portable Fire Extinguishers, fire classification and travel distance. per NFPA 10
- 1.15. Enclosure Protection and Penetration Requirements. - Opening Protectives and Through Penetrations
  - 1.15.1. IBC Section 712, 715 and Table 715.3. Mechanical rooms, exit stairways, storage rooms, janitor [ ] hour rating. IBC Table 302.1.1
  - 1.15.2. Fire Blocks, Draft Stops, Through Penetrations and Opening Protectives
- 1.16. Fire Dampers. Describe where fire dampers and smoke dampers are to be used (IBC Section 716 and NFPA 90A). State whether isolation smoke dampers are required at the air handler.
- 1.17. Detection Alarm and Communication. UFC 3-600-01, (Chapter 5); NFPA 101 para. 3.4 (chapters 12-42); NFPA 72
- 1.18. Mass Notification. Describe building/facility mass notification system (UFC 4-021-01) type and type of base-wide mass notification/communication system. State whether the visible notification appliances will be combined with the fire alarm system or kept separate. (Note: Navy has taken position to combine visible notification appliances with fire alarm).
- 1.19. Interior Finishes (classification). NFPA 101.10.2.3 and NFPA 101.7.1.4
- 1.20. Means of Egress

- 1.20.1. Separation of Means of Egress, NFPA 101 chapters 7 and 12-42; NFPA101.7.1.3
- 1.20.2. Occupant Load, NFPA101.7.3.1 and chapters 12-42.
- 1.20.3. Egress Capacity (stairs, corridors, ramps and doors) NFPA101.7.3.3
- 1.20.4. Number of Means of Egress, NFPA101.7.4 and chapters 12-42.
- 1.20.5. Dead end limits and Common Path of Travel, NFPA 101.7.5.1.6 and chapters 12-42.
- 1.20.6. Accessible Means of Egress (for accessible buildings), NFPA101.7.5.4
- 1.20.7. Measurement of Travel Distance to Exits, NFPA101.7.6 and chapters 12-42.
- 1.20.8. Discharge from Exits, NFPA101.7.7.2
- 1.20.9. Illumination of Means of Egress, NFPA101.7.8
- 1.20.10. Emergency Lighting, NFPA101.7.9
- 1.20.11. Marking of Means of Egress, NFPA101.7.10
- 1.21. Elevators, UFC 3-600-01, Chapter 6; IBC and ASME A17.1 - 2000,(Safety Code for Elevators and Escalators)
- 1.22. Accessibility Requirements, ADA and ABA Accessibility Guidelines for Buildings and Facilities
- 1.23. Certification of Fire Protection and Life Safety Code Requirements. (Note: Edit the Fire team membership if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features for this project in accordance with the attached completed form(s).
- 1.24. Designer of Record. Certification of Fire protection and Life Safety Code Requirements. (Note: Edit the Fire team members if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features of this project.

Fire Protection Engineer of Record:

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Signature and Stamp

Date

OR

Architect of Record:

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Signature and Stamp

Date

Mechanical Engineer of Record:

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Signature and Stamp

Date

Electrical Engineer of Record:

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Signature/Date

**ATTACHMENT E**  
**LEED SUBMITTALS**

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)	Provide for Credit Audit Only	REQUIRED DOCUMENTATION	Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT		DATE	REV
<b>GENERAL</b>						
GENERAL - All calculations shall be in accordance with LEED 2009 Reference Guide.						
GENERAL: Obtain excel version of this spreadsheet at <a href="http://en.sas.usace.army.mil/enWeb/EngineeringCriteria">http://en.sas.usace.army.mil/enWeb/EngineeringCriteria</a> .						
GENERAL - For all credits, narrative/comments may be added to describe special circumstances or considerations regarding the project's credit approach.						
GENERAL - Include all required LEED drawings indicated below in contract drawings with applicable discipline drawings, labeled For Reference Only.						
NOTE: Each submittal indicated with "****" differs from LEED certified project submittals by either having a different due date or being an added submittal not required by GBCI.						
NOTE: Projects seeking LEED certification need only submit to GBCI whatever documentation is acceptable to GBCI (for example, licensed professional certifications). This checklist identifies what must be submitted to the Government for internal review purposes. Government review of LEED documentation in no way supercedes or modifies the requirements and rulings of GBCI for purposes of compliance with project requirement to obtain LEED certification.						
GENERAL - Audit documentation may include but is not limited to what is indicated in this table.						
			Closeout	List of all Final Design submittals revised after final design to reflect actual closeout conditions. Revised Final Design submittals. - OR - Statement confirming that no changes have been made since final design that effect final design submittal documents.		Proj Engr (PE)
<b>CATEGORY 1 - SUSTAINABLE SITES</b>						
SSPR1		Construction Activity Pollution Prevention (PREREQUISITE)	**Final Design	List of drawings and specifications that address the erosion control, particulate/dust control and sedimentation control measures to be implemented.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			**Final Design	Narrative that indicates which compliance path was used (NPDES or Local standards) and describes the measures to be implemented on the project. If a local standard was followed, provide specific information to demonstrate that the local standard is equal to or more stringent than the NPDES program.		CIV
SS1		Site Selection	Final Design	Statement confirming that project does not meet any of the prohibited criteria.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	LEED Site plan drawing that shows all proposed development, line depicting boundary of all bodies of water and/or wetlands within 100 feet of project boundary and a line depicting 5' elevation above 100 year flood line that falls within project boundary. Not required if neither condition applies.		CIV
SS2		Development Density & Community Connectivity	Final Design	Option 1: LEED Site vicinity plan showing project site and surrounding development. Show density boundary or note drawing scale.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: Table indicating, for project site and all surrounding sites within density radius (keyed to site vicinity plan), site area and building area. Project development density calculation. Density radius calculation. Development density calculation within density radius.		CIV
			Final Design	Option 2: LEED Site vicinity plan showing project site, the 1/2 mile community radius, pedestrian walkways and the locations of the residential development(s) and Basic Services surrounding the project site.		CIV
			Final Design	Option 2: List (including business name and type) of all Basic Services facilities within the 1/2 mile radius, keyed to site vicinity plan.		CIV
SS3		Brownfield Redevelopment	Final Design	Narrative describing contamination and the remediation activities included in project. Include statement indicating how site was determined to be a brownfield.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS4.1		Alternative Transportation: Public Transportation Access	Final Design	Statement indicating which option for compliance applies. State whether public transportation is existing or proposed and, if proposed, cite source of this information.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: LEED Site vicinity plan showing project site, mass transit stops and pedestrian path to them with path distance noted.		CIV
			Final Design	Option 2: LEED Site vicinity plan showing project site, bus stops and pedestrian path to them with path distance noted.		CIV
SS4.2		Alternative Transportation: Bicycle Storage & Changing Rooms	Final Design	FTE calculation. Bicycle storage spaces calculation. Shower/changing facilities calculation.		CIV
			Final Design	List of drawings that show the location(s) of bicycle storage areas. Statement indicating distance from building entrance.		CIV
			Final Design	List of drawings that show the location(s) of shower/changing facilities and, if located outside the building, statement indicating distance from building entrance.		CIV

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)	Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT	REQUIRED DOCUMENTATION	DATE	REV
SS4.3		Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	Final Design	Statement indicating which option for compliance applies. FTE calculation. Statement indicating total parking capacity of site.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: Low-emission & fuel-efficient vehicle calculation.		CIV
			Final Design	Option 1: List of drawings and specification references that show location and number of preferred parking spaces for low-emission & fuel-efficient vehicles and signage.		CIV
			Final Design	Option 1: Statement indicating quantity, make, model and manufacturer of low-emission & fuel-efficient vehicles to be provided. Statement confirming vehicles are zero-emission or indicating ACEEE vehicle scores.		CIV
			Final Design	Option 2: Low-emission & fuel-efficient vehicle parking calculation.		CIV
			Final Design	Option 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.		CIV
			Final Design	Option 3: Low-emission & fuel-efficient vehicle refueling station calculation.		CIV
			Final Design	Option 3: List of drawings and specifications indicating location and number of refueling stations, fuel type and fueling capacity for each station for an 8-hour period.		CIV
			Closeout	Option 3: Construction product submittals indicating what was provided and confirming compliance with respect to fuel type and fueling capacity for each station for an 8-hour period.		CIV
SS4.4		Alternative Transportation: Parking Capacity	Final Design	Statement indicating which option for compliance applies.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: Preferred parking calculation including number of spaces required, total provided, preferred spaces provided and percentage.		CIV
			Final Design	Option 2: FTE calculation. Preferred parking calculation including number of spaces provided, preferred spaces provided and percentage.		CIV
			Final Design	Options 1 and 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.		CIV
			Final Design	Option 3: Narrative indicating number of spaces required and provided and describing infrastructure and support programs with description of project features to support them.		CIV
SS5.1		Site Development: Protect or Restore Habitat	**Final Design	Option 1: List of drawing and specification references that convey site disturbance limits.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			**Final Design	Option 2: LEED site plan drawing that delineates boundaries of each preserved and restored habitat area with area (sf) noted for each.		CIV
			**Final Design	Option 2: Percentage calculation of restored/preserved habitat to total site area. List of drawings and specification references that convey restoration planting requirements.		CIV
SS5.2		Site Development: Maximize Open Space	Final Design	Option 2: LEED site plan drawing delineating boundary of vegetated open space adjacent to building with areas of building footprint and designated open space noted.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS6.1		Stormwater Design: Quantity Control	Final Design	Statement indicating which option for compliance applies.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf) -OR - Narrative describing site conditions, measures and controls to be implemented to prevent excessive stream velocities and erosion.		CIV
			Final Design	Option 2: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf). Indicate percent reduction in each.		CIV
SS6.2		Stormwater Design: Quality Control	Final Design	For non-structural controls, list all BMPs used and, for each, describe the function of the BMP and indicate the percent annual rainfall treated. List all structural controls and, for each, describe the pollutant removal and indicate the percent annual rainfall treated.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS7.1		Heat Island Effect: Non-Roof	**Final Design	LEED site plan drawing indicating locations and quantities of each paving type, including areas of shaded pavement. Percentage calculation indicating percentage of reflective/shaded/open grid area.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV

Tuesday, July 13, 2010



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SS7.2		Heat Island Effect: Roof	Final Design	Option 1: Percentage calculation indicating percentage of SRI compliant roof area. List of drawings and specification references that convey SRI requirements and roof slopes.		ARC
			Final Design	Option 1: List of specified roof materials indicating, for each, type, manufacturer, product name and identification if known, SRI value and roof slope.		ARC
			**Closeout	Option 1: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.		PE
			Closeout	X Option 1: Manufacturer published product data or certification confirming SRI		PE
			Final Design	Option 2: Percentage calculation indicating percentage of vegetated roof area.		ARC
			Final Design	Option 3: Combined reflective and green roof calculation.		ARC
			Final Design	Option 3: List of specified roof materials indicating, for each, type, manufacturer, product name and identification if known, SRI value and roof slope.		ARC
			**Closeout	Option 3: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.		PE
			Closeout	X Option 3: Manufacturer published product data or certification confirming SRI		PE
SS8		Light Pollution Reduction	Final Design	Interior Lighting: List of drawings and specification references that convey interior lighting requirements (location and type of all installed interior lighting, location of non-opaque exterior envelope surfaces, allowing confirmation that maximum candela value from interior fixtures does not intersect non-opaque building envelope surfaces). - OR - List of drawings and specification references that show automatic lighting controls compliance with credit requirement.		ELEC
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		ELEC
			Final Design	Exterior Lighting: List of drawings and specification references that convey exterior lighting requirements (location and type of all site lighting and building façade/landscape lighting).		ELEC
			Final Design	Exterior Site Lighting Power Density (LPD): Tabulation for exterior site lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all site lighting.		ELEC
			Final Design	Exterior Building Facade/Landscape Lighting Power Density (LPD): Tabulation for exterior building facade/landscape lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all building facade/landscape lighting.		ELEC
			Final Design	Exterior Lighting IESNA Zone: Indicate which IESNA zone is applicable to the project.		ELEC
			Final Design	Exterior Lighting Site Lumen table indicating, for each fixture type, quantity installed, initial lamp lumens per luminaire, initial lamp lumens above 90 degrees from Nadir, total lamp lumens and total lamp lumens above 90 degrees. Percentage of site lamp lumens above 90 degrees from nadir to total lamp lumens.		ELEC
			Final Design	Exterior Lighting Narrative describing analysis used for addressing requirements for light trespass at site boundary and beyond.		ELEC
<b>CATEGORY 2 – WATER EFFICIENCY</b>						
WEPR1		Water Use Reduction: 20% Reduction	Final Design	Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.		MEC
			Final Design	Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users		MEC
			Final Design	Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.		MEC

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			Final Design	Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.		MEC
			Final Design	Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.		MEC
			Closeout	X Manufacturer published product data or certification confirming fixture water usage.		PE
WE1.1		Water Efficient Landscaping: Reduce by 50%	Final Design	Statement indicating which option for compliance applies.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Calculation indicating, for baseline and design case, total water applied, total potable water applied, total non-potable water applied. Design case percent potable water reduction. If nonpotable water is used, indicate source of nonpotable water.		CIV
			Final Design	List of landscape plan drawings.		CIV
			Final Design	Narrative describing landscaping and irrigation design strategies, including water use calculation methodology used to determine savings and, if non-potable water is used, specific information about source and available quantity.		CIV
WE1.2		Water Efficient Landscaping: No Potable Water Use or No Irrigation	Same as WE1.1	Same as WE1.1		CIV
WE2		Innovative Wastewater Technologies	Final Design	Statement confirming which option for compliance applies.		MEC
			Final Design	Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.		MEC
			Final Design	Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users		MEC
			Final Design	Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.		MEC
			Final Design	Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.		MEC
			Final Design	Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.		MEC
			Final Design	Option 1: If onsite non-potable water is used, identify source(s), indicate annual quantity from each source and indicate total annual quantity from all onsite non-potable water sources.		MEC
			Final Design	Option 1: Summary calculation indicating baseline annual water consumption, design case annual water consumption, non-potable annual water consumption and total percentage annual water savings.		MEC
			Final Design	Option 2: Statement confirming on-site treatment of all generated wastewater to tertiary standards and all treated wastewater is either infiltrated or used on-site.		MEC
			Final Design	Option 2: List of drawing and specification references that convey design of on-site wastewater treatment features.		CIV
			Final Design	Option 2: On-site water treatment quantity calculation indicating all on-site wastewater source(s), annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from each source and totals for annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from all sources.		CIV
			Final Design	Option 2: Wastewater summary calculation indicating design case annual flush fixture water usage, annual on-site water treatment and percentage sewage conveyance reduction.		MEC
			Final Design	Narrative describing project strategy for reduction of potable water use for sewage conveyance, including specific information on reclaimed water usage and treated wastewater usage.		MEC
WE3		Water Use Reduction: 30% - 40% Reduction	Same as WEPR1	Same as WEPR1		MEC

## CATEGORY 3 – ENERGY AND ATMOSPHERE

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EAPR1		Fundamental Commissioning of the Building Energy Systems (PREREQUISITE)	**Final Design	**Owner's Project Requirements document		ALL
			**Final Design	**Basis of Design document for commissioned systems		MEC, ELEC
			**Final Design	**Commissioning Plan		MEC, ELEC
			Closeout	Statement confirming all commissioning requirements have been incorporated into construction documents.		PE
			Closeout	Commissioning Report		PE
EAPR2		Minimum Energy Performance (PREREQUISITE)	Final Design	Statement listing the mandatory provisions of ASHRAE 90.1 that project meets relative to compliance with this prerequisite and indicating which compliance path was used.		MEC ELEC ARC
			Final Design	Statement indicating which compliance path option applies.		MEC
			Final Design	Option 1: Statement confirming simulation software capabilities and confirming assumptions and methodology.		MEC
			Final Design	Option 1: General information including simulation program, principal heating source, percent new construction and renovation, weather file, climate zone and Energy Star Target Finder score.		MEC
			Final Design	Option 1: Space summary listing, for each building use, the conditioned area, unconditioned area and total area and include total area for each category		MEC
			Final Design	Option 1: List of all simulation output advisory message data and show difference between baseline and proposed design		MEC
			Final Design	Option 1: Comparison summary for energy model inputs including description of baseline and design case energy model inputs, showing both by element type		MEC
			Final Design	Option 1: Energy type summary listing, for each energy type, utility rate description, units of energy and units of demand		MEC
			Final Design	Option 1: Statement indicating whether project uses on-site renewable energy. If yes, list all sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost		MEC
			Final Design	Option 1: If analysis includes exceptional calculation methods, statement describing how exceptional calculation measure cost savings is determined		MEC
			Final Design	Option 1: If analysis includes exceptional calculation methods, for each exceptional calculation method indicate energy types and, for each energy type, annual energy savings, annual cost savings, and brief descriptive narrative		MEC
			Final Design	Option 1: Baseline performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand for all four orientations. For each orientation indicate total annual energy use for each orientation and total annual process energy use.		MEC
			Final Design	Option 1: Baseline energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design	Option 1: Proposed Design performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand, baseline annual and peak energy demand and percent savings. Indicate total annual energy use and total annual process energy use for both proposed design and baseline and percent savings.		MEC
			Final Design	Option 1: Proposed Design energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design	Option 1: Energy cost and consumption by energy type report indicating, for each energy type, proposed design and baseline annual use and annual cost, percent savings annual use and annual cost. Indicate for renewable energy annual energy generated and annual cost. Indicate exceptional calculations annual energy savings and annual cost savings. Indicate building total annual energy use, annual energy cost for proposed design and baseline and indicate percent savings annual energy use and annual energy cost.		MEC

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			Final Design	Option 1: Compliance summaries from energy simulation software. If software does not produce compliance summaries provide output summaries and example input summaries for baseline and proposed design supporting data in the tables. Output summaries must include simulated energy consumption by end use and total energy use and cost by energy type. Example input summaries should represent most common systems and must include occupancy, use pattern, assumed envelope component sizes and descriptive features and assumed mechanical equipment types and descriptive features		MEC
			Final Design	Option 1: Energy rate tariff from project energy providers (only if not using LEED Reference Guide default rates)		MEC
EAPR3		Fundamental Refrigerant Management (PREREQUISITE)	Final Design	Statement indicating which option for compliance applies.		MEC
			Final Design	Option 2: Narrative describing phase out plan, including specific information on phase out dates and refrigerant quantities.		MEC
EA1		Optimize Energy Performance	Final Design	Statement indicating which compliance path option applies.		MEC
			Final Design	Option 1: Statement confirming simulation software capabilities and confirming assumptions and methodology.		MEC
			Final Design	Option 1: General information including simulation program, principal heating source, percent new construction and renovation, weather file, climate zone and Energy Star Target Finder score.		MEC
			Final Design	Option 1: Space summary listing, for each building use, the conditioned area, unconditioned area and total area and include total area for each category		MEC
			Final Design	Option 1: List of all simulation output advisory message data and show difference between baseline and proposed design		MEC
			Final Design	Option 1: Comparison summary for energy model inputs including description of baseline and design case energy model inputs, showing both by element type		MEC
			Final Design	Option 1: Energy type summary listing, for each energy type, utility rate description, units of energy and units of demand		MEC
			Final Design	Option 1: Statement indicating whether project uses on-site renewable energy. If yes, list all sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost		MEC
			Final Design	Option 1: If analysis includes exceptional calculation methods, statement describing how exceptional calculation measure cost savings is determined		MEC
			Final Design	Option 1: If analysis includes exceptional calculation methods, for each exceptional calculation method indicate energy types and, for each energy type, annual energy savings, annual cost savings, and brief descriptive narrative		MEC
			Final Design	Option 1: Baseline performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand for all four orientations. For each orientation indicate total annual energy use for each orientation and total annual process energy use.		MEC
			Final Design	Option 1: Baseline energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design	Option 1: Proposed Design performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand, baseline annual and peak energy demand and percent savings. Indicate total annual energy use and total annual process energy use for both proposed design and baseline and percent savings.		MEC
			Final Design	Option 1: Proposed Design energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design	Option 1: Energy cost and consumption by energy type report indicating, for each energy type, proposed design and baseline annual use and annual cost, percent savings annual use and annual cost. Indicate for renewable energy annual energy generated and annual cost. Indicate exceptional calculations annual energy savings and annual cost savings. Indicate building total annual energy use, annual energy cost for proposed design and baseline and indicate percent savings annual energy use and annual energy cost.		MEC

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			Final Design	Option 1: Compliance summaries from energy simulation software. If software does not produce compliance summaries provide output summaries and example input summaries for baseline and proposed design supporting data in the tables. Output summaries must include simulated energy consumption by end use and total energy use and cost by energy type. Example input summaries should represent most common systems and must include occupancy, use pattern, assumed envelope component sizes and descriptive features and assumed mechanical equipment types and descriptive features	MEC
			Final Design	Option 1: Energy rate tariff from project energy providers (only if not using LEED Reference Guide default rates)	MEC
EA2.1		On-Site Renewable Energy	Final Design	Statement indicating which compliance path option applies.	ELEC
			Final Design	List all on-site renewable energy sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost. Indicate total annual energy use (all sources), total annual energy cost (all sources) and percent renewable energy cost.	ELEC MEC
			Final Design	Option 1: Indicate, for renewable energy, proposed design total annual energy generated and annual cost.	ELEC MEC
			Final Design	Option 2: Indicate CBECS building type and building gross area. Provide the following CBECS data: median annual electrical intensity, median annual non-electrical fuel intensity, average electric energy cost, average non-electric fuel cost, annual electric energy use and cost, annual non-electric fuel use and cost.	ELEC MEC
			Final Design	Option 2: Narrative describing renewable systems and explaining calculation method used to estimate annual energy generated, including factors influencing performance.	ELEC MEC
EA2.2		On-Site Renewable Energy	Same as EA2.1	Same as EA2.1	ELEC MEC
EA2.3		On-Site Renewable Energy	Same as EA2.1	Same as EA2.1	ELEC MEC
EA3		Enhanced Commissioning	**Final Design	**Owner's Project Requirements document (OPR)	ALL
			**Final Design	**Basis of Design document for commissioned systems (BOD)	ELEC MEC
			**Final Design	**Commissioning Plan	ELEC MEC
			Closeout	Statement confirming all commissioning requirements have been incorporated into construction documents.	PE
			Closeout	**Commissioning Report	PE
			**Final Design	Statement by CxA confirming Commissioning Design Review	
			Closeout	Statement by CxA confirming review of Contractor submittals for compliance with OPR and BOD	PE
			Closeout	**Systems Manual	PE
			Closeout	Statement by CxA confirming completion of O&M staff and occupant training	PE
			Closeout	**Scope of work for post-occupancy review of building operation, including plan for resolution of outstanding issues	PE
			**Predesign	Statement confirming CxA qualifications and contractual relationships relative to work on this project, demonstrating that CxA is an independent third party.	MEC
EA4		Enhanced Refrigerant Management	Final Design	Refrigerant impact calculation table with all building data and calculation values as shown in LEED 2009 Reference Guide Example Calculations	MEC
			Final Design	Narrative describing any special circumstances or explanatory remarks	
			Closeout	X Cut sheets highlighting refrigerant data for all HVAC components.	PE
EA5		Measurement & Verification	Closeout	Statement indicating which compliance path option applies.	PE
			Closeout	Measurement and Verification Plan including Corrective Action Plan	PE
			Closeout	**Scope of work for post-occupancy implementation of M&V plan including corrective action plan.	PE
EA6		Green Power	Closeout	Statement indicating which compliance path option applies.	PE
			Closeout	Option 1: Indicate proposed design total annual electric energy usage	PE
			Closeout	Option 2: Indicate actual total annual electric energy usage	PE
			Closeout	Option 3: Calculation indicating building type, total gross area, median electrical intensity and annual electric energy use	PE

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			Closeout	Green power provider summary table indicating, for each purchase type, provider name, annual quantity green power purchased and contract term. Indicate total annual green power use and indicate percent green power		PE
			Closeout	Narrative describing how Green Power or Green Tags are purchased		PE
<b>CATEGORY 4 – MATERIALS AND RESOURCES</b>						
MRPR1		Storage & Collection of Recyclables (PREREQUISITE)	Final Design	Statement confirming that recycling area will accommodate recycling of plastic, metal, paper, cardboard and glass. Narrative indicating any other materials addressed and coordination with pickup.		ARC
MR1.1		Building Reuse: Maintain 55% of Existing Walls, Floors & Roof	**Final Design	If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.		ARC
			**Final Design	Spreadsheet listing, for each building structural/envelope element, the existing area and reused area. Total percent reused.		ARC
MR1.2		Building Reuse: Maintain 75% of Existing Walls, Floors & Roof	Same as MR1.1	Same as MR1.1		ARC
MR1.3		Building Reuse: Maintain 95% of Existing Walls, Floors & Roof	Same as MR1.1	Same as MR1.1		ARC
MR1.4		Building Reuse: Maintain 50% of Interior Non-Structural Elements	**Final Design	If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.		ARC
			**Final Design	Spreadsheet listing, for each building interior non-structural element, the existing area and reused area. Total percent reused.		ARC
MR2.1		Construction Waste Management: Divert 50% From Disposal	**Preconstruction	Waste Management Plan		PE
			**Construction Quarterly and Closeout	Spreadsheet calculations indicating material description, disposal/diversion location (or recycling hauler), weight, total waste generated, total waste diverted, diversion percentage		PE
			**Construction Quarterly and Closeout	Receipts/tickets for all items on spreadsheet		PE
MR2.2		Construction Waste Management: Divert 75% From Disposal	Same as MR2.1	Same as MR2.1		PE
MR3.1		Materials Reuse: 5%	Closeout	Statement indicating total materials value and whether default or actual.		PE
			Closeout	Spreadsheet calculations indicating, for each reused/salvaged material, material description, source or vendor, cost. Total reused/salvaged materials percentage.		PE
MR3.2		Materials Reuse: 10%	Same as MR3.1	Same as MR3.1		PE
MR4.1		Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	Closeout	Statement indicating total materials value and whether default or actual.		PE
			Closeout	Spreadsheet calculations indicating, for each recycled content material, material name/description, manufacturer, cost, post-consumer recycled content percent, pre-consumer recycled content percent, source of recycled content data. Total post-consumer content materials cost, total pre-consumer content materials cost, total combined recycled content materials cost, recycled content materials percentage.		PE
			Final Design or NLT Preconstruction	**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		PE
			Closeout	Manufacturer published product data or certification, confirming recycled content percentages in spreadsheet		PE
MR4.2		Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	Same as MR4.1	Same as MR4.1		PE
MR5.1		Regional Materials: 10% Extracted, Processed & Manufactured Regionally	Closeout	Statement indicating total materials value and whether default or actual.		PE
			Closeout	Spreadsheet calculations indicating, for each regional material, material name/description, manufacturer, cost, percent compliant, harvest distance, manufacture distance, source of manufacture and harvest location data. Total regional materials cost, regional materials percentage.		PE
			Preconstruction	**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		PE
			Closeout	Manufacturer published product data or certification confirming regional material percentages in spreadsheet		PE

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MR5.2		Regional Materials:20% Extracted, Processed & Manufactured Regionally	Same as MR5.1		Same as MR5.1		PE
MR6		Rapidly Renewable Materials	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each rapidly renewable material, material name/description, manufacturer, cost, rapidly renewable content percent, rapidly renewable product value. Total rapidly renewable product value, rapidly renewable materials percentage.		PE
			Final Design		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		ARC
			Closeout	X	Manufacturer published product data or certification confirming rapidly renewable material percentages in spreadsheet		PE
MR7		Certified Wood	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each certified wood material, material name/description, vendor, cost, wood component percent, certified wood percent of wood component, FSC chain of custody certificate number. Total certified wood product value, certified wood materials percentage.		PE
			Final Design or NLT Preconstruction		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		PE
			Closeout	X	Vendor invoices, FSC chain of custody certificates and anufacturer published product data or certification confirming all certified wood materials percentages in spreadsheet.		PE
INDOOR ENVIRONMENTAL QUALITY							
EQPR1		Minimum IAQ Performance (PREREQUISITE)	Final Design		Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.		MEC
			Final Design		Narrative describing the project's ventilation design, including specifics about fresh air intake volumes and special considerations.		MEC
EQPR2		Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)	Final Design		Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.		ARC
			Final Design		List of drawing and specification references that convey conformance to applicable requirements (signage, exhaust system, room separation details, etc).		ARC
EQ1		Outdoor Air Delivery Monitoring	Final Design		Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.		MEC
			Final Design		List of drawing and specification references that convey conformance to applicable requirements.		MEC
			Final Design		Narrative describing the project's ventilation design and CO2 monitoring system, including specifics about monitors, operational parameters and setpoints.		MEC
			Closeout	X	Cut sheets for CO2 monitoring system.		PE
EQ2		Increased Ventilation	Final Design		Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.		MEC
			Final Design		Narrative describing the project's ventilation design, including specifics about zone fresh air intake volumes and demonstrating compliance.		MEC
			Final Design		Option 2: Narrative describing design method used for determining natural ventilation design, including calculation methodology/model results and demonstrating compliance.		MEC
			Final Design		List of drawing and specification references that convey conformance to applicable requirements.		MEC
EQ3.1		Construction IAQ Management Plan: During Construction	**Preconstruction		Construction IAQ Management Plan		PE
			Closeout		Statement confirming whether air handling units were operated during construction		PE
			Closeout		Dated jobsite photos showing examples of IAQ management plan practices being implemented. Label photos to indicate which practice they demonstrate. Minimum one photo of each practice at each building.		PE

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			Closeout	Spreadsheet indicating, for each filter installed during construction, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy.		PE
EQ3.2		Construction IAQ Management Plan: Before Occupancy	**Preconstruction	Construction IAQ Management Plan		PE
			Closeout	Statement indicating which option for compliance applies and confirming that required activities have occurred that meet the applicable requirements.		PE
			Closeout	Option 1a: Narrative describing the project's flushout process, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
			Closeout	Option 1b: Narrative describing the project's pre-occupancy and post-occupancy flushout processes, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
			Closeout	Option 2: Narrative describing the project's IAQ testing process, including specifics about contaminants tested for, locations, remaining work at time of test, retest parameters and special considerations (if any).		PE
			Closeout	Option 2: IAQ testing report demonstrating compliance.		PE
EQ4.1		Low Emitting Materials: Adhesives & Sealants	Closeout	Spreadsheet indicating, for each applicable indoor adhesive, sealant and sealant primer used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.		PE
			Closeout	Spreadsheet indicating, for each applicable indoor aerosol adhesive, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor aerosol adhesives were used for the project.		PE
			Closeout	Manufacturer published product data or certification confirming material VOCs in spreadsheet		PE
EQ4.2		Low Emitting Materials: Paints & Coatings	Closeout	Spreadsheet indicating, for each applicable indoor paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.		PE
			Closeout	Spreadsheet indicating, for each applicable indoor anti-corrosive/anti-rust paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor anti-corrosive/anti-rust paints were used for the project.		PE
			Closeout	Manufacturer published product data or certification confirming material VOCs in spreadsheet		PE
EQ4.3		Low Emitting Materials: Flooring Systems	Closeout	Spreadsheet indicating, for each indoor flooring system used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data.		PE
			Closeout	Spreadsheet indicating, for each indoor carpet cushion used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data - OR - Statement confirming no indoor carpet cushion was used for the project.		PE
			Closeout	Manufacturer published product data or certification confirming material compliance label in spreadsheet		PE
EQ4.4		Low Emitting Materials: Composite Wood & Agrifiber Products	Closeout	Spreadsheet indicating, for each indoor composite wood and agrifiber product used, the manufacturer, product name/model number, if it contains added urea formaldehyde (yes/no) and source of LEED compliance data.		PE
			Closeout	Manufacturer published product data or certification confirming material urea formaldehyde in spreadsheet		PE
EQ5		Indoor Chemical & Pollutant Source Control	Closeout	Spreadsheet indicating, for each permanent entryway system used, the manufacturer, product name/model number and description of system.		PE
			Final Design	List of drawing and specification references that convey locations and installation methods for entryway systems.		ARC
			Final Design	Spreadsheet indicating, for each chemical use area, the room number, room name, description of room separation features (walls, floor/ceilings, openings) and pressure differential from surrounding spaces with doors closed - OR - Statement confirming that project includes no chemical use areas and that no hazardous cleaning materials are needed for building maintenance.		ARC MEC
			Final Design	If project includes chemical use areas: List of drawing and specification references that convey locations of chemical use areas, room separation features and exhaust system.		ARC

Tuesday, July 15, 2010



LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)	Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT	REQUIRED DOCUMENTATION	DATE	REV
			Final Design	If project includes places where water and chemical concentrate mixing occurs: List of drawing and specification references that convey provisions for containment of hazardous liquid wastes OR - Statement confirming that project includes no places where water and chemical concentrate mixing occurs.		ARC MEC
			Closeout	If project includes chemical use areas: Spreadsheet indicating, for AHUs/mechanical ventilation equipment serving occupied areas, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy (yes/no) - OR - Statement confirming that project does not use mechanical equipment for ventilation of occupied areas.		PE
EQ6.1		Controllability of Systems: Lighting	Final Design	Calculation indicating total number of individual workstations, number of workstations with individual lighting controls and the percentage of workstations with individual lighting controls.		ELEC
			Final Design	For each shared multi-occupant space, provide a brief description of lighting controls.		ELEC
			Final Design	Narrative describing lighting control strategy, including type and location of individual controls and type and location of controls in shared multi-occupant spaces.		ELEC
EQ6.2		Controllability of Systems: Thermal Comfort	Final Design	Calculation indicating total number of individual workstations, number of workstations with individual thermal comfort controls and the percentage of workstations with individual thermal comfort controls.		MEC
			Final Design	For each shared multi-occupant space, provide a brief description of thermal comfort controls.		MEC
			Final Design	Narrative describing thermal comfort control strategy, including type and location of individual and shared multi-occupant controls.		MEC
EQ7.1		Thermal Comfort: Design	Final Design	Design criteria spreadsheet indicating, for spring, summer, fall and winter, maximum indoor space design temperature, minimum indoor space design temperature and maximum indoor space design humidity.		MEC
			Final Design	Narrative describing method used to establish thermal comfort control conditions and how systems design addresses the design criteria, including compliance with the referenced standard.		MEC
EQ7.2		Thermal Comfort: Verification	Final Design	Narrative describing the scope of work for the thermal comfort survey, including corrective action plan development		MEC
			Final Design	List of drawing and specification references that convey permanent monitoring system.		MEC
EQ8.1		Daylight & Views: Daylight 75% of Spaces	Final Design	Option 2: Table indicating all regularly occupied spaces with space area and space area with compliant daylight zone. Sum of regularly occupied areas and regularly occupied areas with compliant daylight zone. Percentage calculation of areas with compliant daylight zone to total regularly occupied areas.		ARC
			Final Design	Option 1: Simulation model method, software and output data		ELEC
			Final Design	Option 1: Table indicating all regularly occupied spaces with space area, space area with minimum 25 footcandles daylighting illumination, and method of providing glare control. Sum of regularly occupied areas and regularly occupied areas with 25 fc daylighting. Percentage calculation of areas with 25 fc daylighting to total regularly occupied areas.		ELEC
			Final Design	For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.		ARC
			Final Design	List of drawing and specification references that convey exterior glazed opening head and sill heights, glazing performance properties and glare control/sunlight redirection devices.		ARC
			Closeout	Manufacturer published product data or certification confirming glazing Tvis in spreadsheet		PE
EQ8.2		Daylight & Views: Views for 90% of Spaces	Final Design	Table indicating all regularly occupied spaces with space area and space area with access to views. Sum of regularly occupied areas and regularly occupied areas with access to views. Percentage calculation of areas with views to total regularly occupied areas.		ARC
			Final Design	For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.		ARC
			Final Design	LEED Floor plan drawings showing line of sight diagramming of views areas in each regularly occupied space. List of drawing/specification references that convey exterior glazed opening head and sill heights.		ARC
INNOVATION & DESIGN PROCESS						

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT		REQUIRED DOCUMENTATION	DATE	REV
IDc1.1		Innovation in Design	Final Design		Narrative describing intent, requirement for credit, project approach to the credit. List of drawings and specification references that convey implementation of credit. All other documentation that validates claimed credit.		
IDc1.2		Innovation in Design	Final Design				
IDc1.3		Innovation in Design	Final Design				
IDc1.4		Innovation in Design	Final Design				
IDc2		LEED Accredited Professional	Final Design		Narrative indicating name of LEED AP, company name of LEED AP, description of LEED AP's role and responsibilities in the project.		ARC





**ATTACHMENT F**  
Version 02-03-2010**BUILDING INFORMATION MODELING REQUIREMENTS****1.0 Section 1 - Submittal Format**

1.1. Design Deliverables. Develop all designs using Building Information Modeling (BIM) and Computer Aided Design (CAD) software. Design submittal drawings shall be A1 size, suitable for half-size scaled reproduction.

**2.0 Section 2 – Design Requirements**

2.1. BIM Model and Facility Data. Contractor shall use BIM application(s) and software(s) to develop project designs. “Facility Data” is defined as associated intelligent attribute data. The “Model” is defined as 3D graphics that includes Facility Data and output as described in the paragraph ‘Output’ below. Contractors will use the Model to produce accurate Construction Documents. All submitted BIM Models and associated Facility Data shall be fully compatible with Autodesk Revit 9.0 or higher

2.1.1. Reference. Refer to ERDC TR-06-10, “U.S. Army Corps of Engineers Building Information Modeling Road Map” from the CAD/BIM Technology Center website for more information on the USACE BIM implementation goals.

2.2. Drawings. Deliver CAD files used for the creation of the Construction Documents Drawings per requirements in Section 01 33 16, the criteria of the USACE Norfolk District District, and as noted herein. Specification of a CAD file format for these Drawings does not limit which BIM application(s) or software(s) may be used for project development and execution.

2.2.1. IFC Support. The Contractor’s selected BIM application(s) and software(s) must support the IFC (Industry Foundation Class - see [www.iai-tech.org](http://www.iai-tech.org)). Submit any deviations from or additions to the IFC property sets for any new spaces, systems, and equipment for Government approval.

2.2.2. Submittal Requirements. BIM submittals shall conform to the requirements of Sections 3 and 4 below.

2.2.3. BIM Project Execution Plan.

2.2.3.1. Develop a BIM Project Execution Plan (“Plan” or “PxP”) documenting the BIM and analysis technologies selected for the Project Model (integrated with the AEC CAD Standard) from concept development through As-Built as a design, production, coordination, construction, and documentation tool and the collaborative process by which it shall be executed. See Section 7 for additional guidance on developing the Plan.

2.2.4. BIM Requirements.

2.2.4.1. Facility Data. Develop the Facility Data consisting of a set of intelligent elements for the Model (e.g., doors, air handlers, electrical panels). This Facility Data shall include all material definitions and attributes that are necessary for the Project facility design and construction. Additional data in support of Section 6 Contractor Electives is encouraged.

2.2.4.2. Model Content. The Model and Facility Data shall include, at a minimum, the requirements of Section 4 below.

2.2.4.3. Model Granularity. Models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on a quarter inch (1/4” = 1’0”) scaled drawing (e.g. at least 1/16<sup>th</sup>, 1/8<sup>th</sup> and 1/4<sup>th</sup>), or appropriately scaled civil drawings.

2.2.4.4. Output. Submitted CAD drawings (e.g., plans, elevations, sections, schedules, details, etc.) shall be derived (commonly known as extractions, views or sheets) and maintained from the submitted Model and Facility Data.

2.3. Quality Control. Implement quality control (QC) parameters for the Model, including:

2.3.1. Model Standards Checks. QC validation used to ensure that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements. Report non-compliant elements and corrective action plan to correct non-compliant elements. Provide the government with detailed justification and request government approval for any non-compliant element which the contractor proposes to be allowed to remain in the Model.

2.3.2. CAD Standards Checks. QC checking performed to ensure that the fonts, dimensions, line styles, levels and other construction document formatting issues are followed per the A/E/C CADD Standard.

2.3.3. Other Parameters. Develop such other QC parameters as Contractor deems appropriate for the Project and provide to the Government for concurrence.

2.4. Design and Construction Reviews. Perform design and construction reviews at each submittal stage under Section 3 to test the Model, including:

2.4.1. Visual Checks. Check to ensure the design intent has been followed and that there are no unintended elements in the Model.

2.4.2. Interference Management Checks. Locate conflicting spatial data in the Model where two elements are occupying the same space. Log hard interferences (e.g., mechanical vs. structural or mechanical vs. mechanical overlaps in the same location) and soft interferences, (e.g., conflicts regarding equipment clearance, service access, fireproofing, insulation) in a written report and resolve.

2.4.3. IFC Coordination View. Provide an IFC Coordination View in IFC Express format for all deliverables. Provide exported property set data for all IFC supported named building elements.

2.4.4. Other Parameters. Develop such other Review parameters as the Contractor deems appropriate for the Project and provide to the Government for concurrence.

### **3.0 Section 3 – Design Stage Submittal Requirements**

3.1. General Submittal Requirements.

3.1.1. Provide submittals in compliance with BIM Project Execution Plan deliverables at stages as described hereinafter.

3.1.2. At each Stage in Paragraphs 3.3 through 3.6, provide a Contractor-certified written report confirming that consistency checks as identified in Paragraphs 2.3 and 2.4 have been completed. This report shall be discussed as part of the review process and shall address cross-discipline interferences, if any.

3.1.3. At each Stage in Paragraphs 3.3 through 3.6, provide the Government with:

- The Model, Facility Data, and CAD Data files.
- A 3-D interactive review format of the Model in Bentley Navigator, Autodesk Navisworks, Adobe 3D PDF 7.0 (or later), Google Earth KMZ or other format per Plan requirements. The file format for reviews can change between submittals.
- A list of all submitted files. The list should include a description, directory, and file name for each file submitted. For all CAD sheets, include the sheet title and sheet number. Identify files that have been produced from the submitted Model and Facility Data.

3.1.4. The Government shall confirm acceptability of all submittals identified in Section 3 in coordination with the USACE Norfolk District BIM Manager

3.2. Initial Design Conference Submittal.

3.2.1. Submit a digital copy of the Plan where, in addition to Paragraph 3.1.4, the USACE Norfolk District District BIM Manager will confirm acceptability of the Plan or advise as to additional processes or activities necessary to be incorporated.

3.2.2. Within thirty (30) days after the approval of the Plan, conduct a demonstration to review the Plan for clarification, and to verify the functionality of Model technology workflow and processes. If modifications are required, the Contractor shall complete the modifications and resubmit the Plan and perform subsequent demonstration for Government acceptance. There will be no payment for design or construction until the Plan is acceptable to the Government. The Government may also withhold payment for design and construction for unacceptable performance in executing the approved Plan.

3.3. Interim Design Submittals.

3.3.1. BIM and CAD Data. The Model shall include the requirements identified in Paragraph 2.2.4 as applicable to the Interim Design package(s).

3.4. Final Design Submissions and Design Complete Submittals.

3.4.1. BIM and CAD Data. The Model shall include the requirements identified in Paragraph 2.2.4. Acceptance according to Paragraph 3.1.4 is required before commencement of construction, as described in Paragraph 3.7.6 of Section 01 33 16.

3.5. Submittals – Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model, including interference management and design change tracking information.

3.6. Final As-Builts BIM and CAD Data Submittal. Submit the final Model, Facility Data, and CAD files reflecting as-built conditions for Government Approval, as specified in Section 01 78 02.00 10, PROJECT CLOSEOUT.

#### 4.0 Section 4 – BIM Model Minimum Requirements and Output

4.1. General Provisions. The deliverable Model shall be developed to include the systems described below as they would be built and the processes of installing them, and to reflect final as-built conditions. The deliverable model at the interim design stage and at the final design stage (“released for construction”) shall be developed to include as many of the systems described below as are necessary and appropriate at that design stage.

4.2. Architectural/Interior Design. The Architectural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4”=1’0”) scaled drawing. Additional minimum Model requirements include:

4.2.1. Spaces. The Model shall include spaces defining accurate net square footage and net volume, and holding data for the room finish schedule for including room names and numbers. Include Programmatic Information provided by the Government or validated program to verify design space against programmed space, using this information to validate area quantities.

4.2.2. Walls and Curtain Walls. Each wall shall be depicted to the exact height, length, width and ratings (thermal, acoustic, fire) to properly reflect wall types. The Model shall include all walls, both interior and exterior, and the necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.2.3. Doors, Windows and Louvers. Doors, windows and louvers shall be depicted to represent their actual size, type and location. Doors and windows shall be modeled with the necessary intelligence to produce accurate window and door schedules.

4.2.4. Roof. The Model shall include the roof configuration, drainage system, penetrations, specialties, and the necessary intelligence to produce accurate plans, building sections and generic wall sections where roof design elements are depicted.

4.2.5. Floors. The floor slab shall be developed in the structural Model and then referenced by the architectural Model for each floor of the Project building.

4.2.6. Ceilings. All heights and other dimensions of ceilings, including soffits, ceiling materials, or other special conditions shall be depicted in the Model with the necessary intelligence to produce accurate plans, building sections and generic wall sections where ceiling design elements are depicted.

4.2.7. Vertical Circulation. All continuous vertical components (i.e., non-structural shafts, architectural stairs, handrails and guardrails) shall be accurately depicted and shall include the necessary intelligence to produce accurate plans, elevations and sections in which such design elements are referenced.

4.2.8. Architectural Specialties and Woodwork. All architectural specialties (i.e., toilet room accessories, toilet partitions, grab bars, lockers, and display cases) and woodwork (i.e., cabinetry and counters) shall be accurately depicted with the necessary intelligence to produce accurate plans, elevations and sections in which such design elements are referenced.

4.2.9. Signage. The Model shall include all signage and the necessary intelligence to produce accurate plans and schedules.

4.2.10. Schedules. Provide door, window, hardware sets using BHMA designations, flooring, wall finish, and signage schedules from the Model, indicating the type, materials and finishes used in the design.

4.3. Furniture. The furniture systems Model may vary in level of detail for individual elements within a Model, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing, and have necessary intelligence to produce accurate plans. Representation of furniture elements is to be 2D. Contractor may provide a minimal number of 3D representations as examples. Examples of furniture include, but are not limited to, desks, furniture systems, seating, tables, and office storage.

4.3.1. Furniture Coordination. Furniture that makes use of electrical, data or other features shall include the necessary intelligence to produce coordinated documents and data.

4.4. Equipment. The Model may vary in level of detail for individual elements within a Model. Equipment shall be depicted to meet layout requirements with the necessary intelligence to produce accurate plans and minimum schedules depicting their configuration. Examples of equipment include but are not limited to copiers, printers, refrigerators, ice machines and microwaves.

4.4.1. Schedules. Provide furniture and equipment schedules from the model indicating the materials, finishes, mechanical, and electrical requirements.

4.5. Structural. The structural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

4.5.1. Foundations. All necessary foundation and/or footing elements, with necessary intelligence to produce accurate plans and elevations.

4.5.2. Floor Slabs. Structural floor slabs shall be depicted, including all necessary recesses, curbs, pads, closure pours, and major penetrations accurately depicted.

4.5.3. Structural Steel. All steel columns, primary and secondary framing members, and steel bracing for the roof and floor systems (including decks), including all necessary intelligence to produce accurate structural steel framing plans and related building/wall sections.

4.5.4. Cast-in-Place Concrete. All walls, columns, and beams, including necessary intelligence to produce accurate plans and building/wall sections depicting cast-in-place concrete elements.

4.5.5. Expansion/Contraction Joints. Joints shall be accurately depicted.



4.5.6. Stairs. The structural Model shall include all necessary openings and framing members for stair systems, including necessary intelligence to produce accurate plans and building/wall sections depicting stair design elements.

4.5.7. Shafts and Pits. The structural Model shall include all necessary shafts, pits, and openings, including necessary intelligence to produce accurate plans and building/wall sections depicting these design elements.

4.6. Mechanical. The mechanical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Small diameter (less than 1-1/2" NPS) field-routed piping is not required in the model. Additional minimum Model requirements include:

4.6.1. HVAC. All necessary heating, ventilating, air-conditioning and specialty equipment, including air distribution ducts for supply, return, and ventilation and exhaust ducts, including control system, registers, diffusers, grills and hydronic baseboards with necessary intelligence to produce accurate plans, elevations, building/wall sections and schedules.

4.6.1.1. Mechanical Piping. All necessary piping and fixture layouts, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, and schedules.

4.6.2. Plumbing. All necessary plumbing piping and fixture layouts, floor and area drains, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules.

4.6.3. Equipment Clearances. All HVAC and Plumbing equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.6.4. Elevator Equipment. The Model shall include the necessary equipment and control system, including necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.7. Electrical/Telecommunications. The electrical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Small diameter (less than 1-1/2"Ø) field-routed conduit is not required in the model. Additional minimum Model requirements include:

4.7.1. Interior Electrical Power and Lighting. All necessary interior electrical components (i.e., lighting, receptacles, special and general purpose power receptacles, lighting fixtures, panelboards, cable trays and control systems), including necessary intelligence to produce accurate plans, details and schedules. Lighting and power built into furniture/equipment shall be modeled.

4.7.2. Special Electrical Systems. All necessary special electrical components (i.e., security, Mass Notification, Public Address, nurse call and other special occupancies, and control systems), including necessary intelligence to produce accurate plans, details and schedules.

4.7.3. Grounding Systems. All necessary grounding components (i.e., lightning protection systems, static grounding systems, communications grounding systems, bonding), including necessary intelligence to produce accurate plans, details and schedules.

4.7.4. Communications. All existing and new communications service controls and connections, both above ground and underground with necessary intelligence to produce accurate plans, details and schedules. Cable tray routing shall be modeled without detail of cable contents.

4.7.5. Exterior Building Lighting. All necessary exterior lighting with necessary intelligence to produce accurate plans, elevations and schedules. The exterior building lighting Model shall include all necessary lighting, relevant existing and proposed support utility lines and equipment required with necessary intelligence to produce accurate plans, details and schedules.

4.7.6. Equipment Clearances. The model shall incorporate and define all electrical and communications working spaces, clearances, and required access

4.8. Fire Protection. The fire protection system Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing.

Additional minimum Model requirements include:

4.8.1. Fire Protection System. All relevant fire protection components (i.e., branch piping, sprinkler heads, fittings, drains, pumps, tanks, sensors, control panels) with necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules. All fire protection piping shall be modeled.

4.8.2. Fire Alarms. Fire alarm/mass notification devices and detection system shall be indicated with necessary intelligence to produce accurate plans depicting them.

4.9. Civil. The civil Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a one inch (1"=100') scaled drawing. Additional minimum Model requirements include:

4.9.1. Terrain (DTM). All relevant site conditions and proposed grading, including necessary intelligence to produce accurate Project site topographical plans and cross sections.

4.9.2. Drainage. All existing and new drainage piping, including upgrades thereto, including necessary intelligence to produce accurate plans and profiles for the Project site.

4.9.3. Storm Water and Sanitary Sewers. All existing and new sewer structures and piping, including upgrades thereto, on the Project site with necessary connections to mains or other distribution points as appropriate, including necessary intelligence to produce accurate plans and profiles for the Project site.

4.9.4. Utilities. All necessary new utilities connections from the Project building(s) to the existing or newly-created utilities, and all existing above ground and underground utility conduits, including necessary intelligence to produce accurate plans and site-sections.

4.9.5. Roads and Parking. All necessary roadways and parking lots or parking structures, including necessary intelligence to produce accurate plans, profiles and cross-sections.

## **5.0 Section 5 - Ownership and Rights in Data**

5.1. Ownership. The Government has ownership of and rights at the date of Closeout Submittal to all CAD files, BIM Model, and Facility Data developed for the Project in accordance with FAR Part 27, clauses incorporated in Section 00 72 00, Contract Clauses and Special Contract Requirement 1.14 GOVERNMENT RE-USE OF DESIGN (Section 00 73 00). The Government may make use of this data following any deliverable.

## **6.0 Section 6 – Contractor Electives**

6.1. Applicable Criteria. If the Contractor elected to include one or more of the following features as an elective in its accepted contract proposal for additional credit during the source selection, as described in the proposal submission requirements and evaluation criteria, the following criteria are requirements, as applicable to those elective feature(s).

6.2. COBIE Compliance. The Model and Facility Data for the Project shall fulfill Construction Operations Building Information Exchange (COBIE) requirements as defined by the Whole Building Design Guide organization, including all requirements for the indexing and submission of Portable Document Format (PDF) and other appropriate file formats that would otherwise be printed and submitted in compliance with Project operations and maintenance handover requirements.

6.3. Project Scheduling using the Model. In the BIM Execution Plan and during the Preliminary BIM Execution Plan Review, provide an overview of the use of BIM in the development and support of the project construction schedule.

6.3.1. Submittal Requirements. During the Submittal stages, the Contractor shall deliver the construction schedule with information derived from the Model.

6.3.1.1. Construction Submittals – Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model for project scheduling.

6.4. Cost Estimating. In the BIM Execution Plan and during the Preliminary BIM Execution Plan Review, provide an overview of the use of BIM in the development and support of cost estimating requirements, or other applications such as cost analysis and estimate validation.

6.4.1. Submittal Requirements. During the Submittal stages, the Contractor shall deliver cost estimating information derived from the Model.

6.4.2. Project completion. At project completion, the Contractor shall provide an MII (Micro Computer Aided Cost Estimating System Generation II) Cost Estimate which follows the USACE Cost Engineering Military Work Breakdown System (WBS), a modified Uniformat, to at least the sub-systems level and uses quantity information supplied directly from BIM output to the maximum extent possible, though other "Gap" quantity information will be included as necessary for a complete and accurate cost estimate.

6.4.2.1. Sub system level extracted quantities from the BIM for use within the estimate shall be provided according to how detailed line items or tasks should be installed/built so that accurate costs can be developed and/or reflected. Therefore, when developing a BIM, the designer shall be cognizant of what tasks need to be separated appropriately at the beginning stages of model development, such as tasks done on the first floor versus the same task on higher floors that will be more labor intensive and therefore need to have a separate quantity and be priced differently. Tasks and their extracted quantities from the BIM shall be broken down by their location (proximity in the structure) as well as the complexity of its installation.

6.4.2.2. At all design stages it shall be understood that BIM output as described in this document will not generate all quantities that are necessary in order to develop a complete and accurate cost estimate of the project based on the design. An example of this would be plumbing that is less than 1.5" diameter and therefore not expected to be modeled due to granularity; this information is commonly referred to as The Gap. Quantities from The Gap and their associated costs shall be included in the final project actual cost estimates as well.

6.5. Other Analyses and Reports. Structural, energy and efficiency, EPACT 2005 & EISA 2007, lighting design, daylighting, electrical power, psychrometric processing, shading, programming, LEED, fire protection, code compliance, Life Cycle Cost, acoustic, plumbing.

## **7.0 Section 7 – BIM Project Execution Plan Template**

7.1. Contractors will utilize the latest version of the USACE BIM PROJECT EXECUTION PLAN (USACE PxP) Template to develop an acceptable Plan. The template can be downloaded from the CAD/BIM Technology Center website.

**ATTACHMENT G****DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT**

Organize electronic design submittal files in a subdirectory/file structure in accordance with the following table. The Contractor may suggest a slightly different structure, subject to the discretion of the government.

**Design Submittal Directory and Subdirectory File Arrangement.**

Directory	Sub-Directory	Sub-Directory or Files	Files
Submittal/Package Name	Narratives	PDF file or files with updated design narrative for each applicable design discipline	
	Drawings	PDF (subdirectory)	Single PDF file with all applicable drawing sheets - bookmarked by sheet number and name
		BIM (subdirectory) See Attachment F.	BIM project folder (with files) per the USACE Workspace. Include an Excel drawing index file with each drawing sheet listed by sheet #, name and corresponding dgn file name (Final Design & Design Complete only)
	Design Analysis & Calculations	Individual PDF files containing design analysis and calculations for each discipline applicable to the submittal	
		PDF file with Fire Protection and Life Safety Code Review checklist	
	LEED	PDF file with updated Leed Check List	
		PDF file or files with LEED Templates for each point with applicable documentation included in each file.	
		LEED SUBMITTALS	
	Energy Analysis	PDF with baseline energy consumption analysis	
		PDF with actual building energy consumption analysis	
	Specifications	Single PDF file with table of contents and all applicable specifications sections.	
		Submittal Register (Final Design & Design Complete submittal only)	
	Design Quality Control	PDF file or files with DQC checklist(s) and/or statements	
	Building Rendering(s)	PDF file of rendering for each building type included in contract (Final Design & Design Complete).	

**SECTION 01 45 01.10**  
**QUALITY CONTROL SYSTEM (QCS)**

**1.0 GENERAL**

- 1.1. CORRESPONDENCE AND ELECTRONIC COMMUNICATIONS
- 1.2. QCS SOFTWARE
- 1.3. SYSTEM REQUIREMENTS
- 1.4. RELATED INFORMATION
- 1.5. CONTRACT DATABASE
- 1.6. DATABASE MAINTENANCE
- 1.7. IMPLEMENTATION
- 1.8. DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM
- 1.9. MONTHLY COORDINATION MEETING
- 1.10. NOTIFICATION OF NONCOMPLIANCE

## 1.0 GENERAL

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. The Contractor module, user manuals, updates, and training information can be downloaded from the RMS web site. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

- Administration
- Finances
- Quality Control
- Submittal Monitoring
- Scheduling
- Import/Export of Data
- Request for Information
- Accident Reporting
- Safety Exposure Manhours

### 1.1. CORRESPONDENCE AND ELECTRONIC COMMUNICATIONS

For ease and speed of communications, both Government and Contractor will exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

### 1.2. OTHER FACTORS

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01 32 01.00 10, PROJECT SCHEDULE, Section 01 33 00, SUBMITTAL PROCEDURES, and Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

### 1.3. QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available.

### 1.4. SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

#### (a) Hardware

- IBM-compatible PC with 1000 MHz Pentium or higher processor
- 256 MB RAM for workstation / 512+ MB RAM for server
- 1 GB hard drive disk space for sole use by the QCS system
- Compact disk (CD) Reader, 8x speed or higher
- SVGA or higher resolution monitor (1024 x 768, 256 colors)
- Mouse or other pointing device
- Windows compatible printer (Laser printer must have 4+ MB of RAM)
- Connection to the Internet, minimum 56K BPS

## (b) Software

- MS Windows 2000 or higher
- MS Word 2000 or newer
- Latest version of : Netscape Navigator, Microsoft Internet Explorer, or other browser that supports HTML 4.0 or higher
- Electronic mail (E-mail), MAPI compatible
- Virus protection software that is regularly upgraded with all issued manufacturer's updates

## 1.5. RELATED INFORMATION

## 1.5.1. QCS USER GUIDE

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

## 1.5.2. CONTRACTOR QUALITY CONTROL (CQC) TRAINING

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

## 1.6. CONTRACT DATABASE

Prior to the pre-construction conference, the Government will provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by using the government's SFTP repository built into QCS import/export function. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

## 1.7. DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Data updates to the Government, e.g., daily reports, submittals, RFI's, schedule updates, payment requests, etc. shall be submitted using the government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, email or CD-ROM may be used instead (see Paragraph DATA SUBMISSION VIA CD-ROM). The QCS database typically shall include current data on the following items:

## 1.7.1. ADMINISTRATION

## 1.7.1.1. Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format.

## 1.7.1.2. Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format.

## 1.7.1.3. Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main)

office shall be prefixed with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

All Requests For Information (RFI) shall be exchanged using the Built-in RFI generator and tracker in QCS.

#### 1.7.1.4. Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

#### 1.7.1.5. Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

### 1.7.2. FINANCES

#### 1.7.2.1. Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the design and construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

#### 1.7.2.2. Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet prompt payment certification, and payment invoice in QCS. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment request, prompt payment certification, and payment invoice with supporting data by using the government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, E-mail or a CD-ROM may be used. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

#### 1.7.3. Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a QCS update reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

#### 1.7.3.1. Daily Contractor Quality Control (CQC) Reports

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government within 24 hours after the date covered by the report. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

#### 1.7.3.2. Deficiency Tracking



The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

#### 1.7.3.3. QC Requirements

The Contractor shall develop and maintain a complete list of QC testing and required structural and life safety special inspections required by the International Code Council (ICC), transferred and installed property, and user training requirements in QCS. The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

#### 1.7.3.4. Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

#### 1.7.3.5. Labor and Equipment Hours

The Contractor shall log labor and equipment exposure hours on a daily basis. This data will be rolled up into a monthly exposure report.

#### 1.7.3.6. Accident/Safety Tracking Reporting

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This supplemental entry is not to be considered as a substitute for completion of mandatory notification and reports, e.g., ENG Form 3394 and OSHA Form 300.

#### 1.7.3.7. Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

#### 1.7.3.8. Hazard Analysis

The Contractor shall use QCS to develop a hazard analysis for each feature of work included in its CQC Plan. The hazard analysis shall address any hazards, or potential hazards, that may be associated with the work

#### 1.7.4. Submittal Management

The Government will provide the submittal register form, ENG Form 4288, SUBMITTAL REGISTER, in electronic format. The Contractor and Designer of Record (DOR) shall develop and maintain a complete list of all submittals, including completion of all data columns and shall manage all submittals. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. QCS and RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

#### 1.7.5. Schedule

The Contractor shall develop a design and construction schedule consisting of pay activities, in accordance with Section 01 32 01.00 10, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01 32 01.00 10 PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

#### 1.7.5.1. Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data from RMS, and schedule data using SDEF.

#### 1.8. IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

#### 1.9. DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of QCS data is by using the government's SFTP repository built into QCS export function.. Other data should be submitted using E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of CD-ROM for data transfer. Data on CDs shall be exported using the QCS built-in export function. If used, CD-ROMs will be submitted in accordance with the following:

##### 1.9.1. File Medium

The Contractor shall submit required data on CD-ROMs. They shall conform to industry standards used in the United States. All data shall be provided in English.

##### 1.9.2. Disk Or Cd-Rom Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

##### 1.9.3. File Names

The files will be automatically named by the QCS software. The naming convention established by the QCS software shall not be altered in any way by the Contractor.

#### 1.10. MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions.

The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

#### 1.11. NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

End of Section 01 45 01.10

**SECTION 01 45 04.00 10**  
**CONTRACTOR QUALITY CONTROL**

**1.0 GENERAL**

1.1. REFERENCES

1.2. PAYMENT

**2.0 PRODUCTS (NOT APPLICABLE)**

**3.0 EXECUTION**

3.1. GENERAL REQUIREMENTS

3.2. QUALITY CONTROL PLAN

3.3. COORDINATION MEETING

3.4. QUALITY CONTROL ORGANIZATION

3.5. SUBMITTALS AND DELIVERABLES

3.6. CONTROL

3.7. TESTS

3.8. COMPLETION INSPECTION

3.9. DOCUMENTATION

3.10. NOTIFICATION OF NONCOMPLIANCE

## **1.0 GENERAL**

### **1.1. REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Refer to the latest edition, as of the date of the contract solicitation.

- ASTM INTERNATIONAL (ASTM)
- ASTM D 3740 Minimum Requirements for Agencies  
Engaged in the Testing and/or Inspection  
of Soil and Rock as Used in Engineering  
Design and Construction
- ASTM E 329 Agencies Engaged in the Testing  
and/or Inspection of Materials Used in  
Construction
- U.S. ARMY CORPS OF ENGINEERS (USACE)  
ER 1110-1-12 Quality Management

### **1.2. PAYMENT**

There will be no separate payment for providing and maintaining an effective Quality Control program. Include all costs associated therewith in the applicable unit prices or lump-sum prices contained in the Contract Line Item Schedule.

## **2.0 PRODUCTS (Not Applicable)**

## **3.0 EXECUTION**

### **3.1. GENERAL REQUIREMENTS**

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product, which complies with the contract requirements. The system shall cover all design and construction operations, both onsite and offsite, and shall be keyed to the proposed design and construction sequence. The site project superintendent is responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

### **3.2. QUALITY CONTROL PLAN**

Furnish for Government review, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Design and construction may begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. The Government will not permit work outside of the features of work included in an accepted interim plan to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started. Where the applicable Code issued by the International Code Council calls for an inspection by the Building Official, the Contractor shall include the inspections in the Quality Control Plan and shall perform the inspections. The Designer of Record shall develop a program for any special inspections required by the applicable International Codes and the Contractor shall perform these inspections, using qualified inspectors. Include the special inspection plan in the QC Plan.

### 3.2.1. Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect/engineers (AE), fabricators, suppliers, and purchasing agents:

3.2.1.1. A description of the quality control organization. Include a chart showing lines of authority and an acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. A CQC System Manager shall report to the project superintendent or someone higher in the contractor's organization.

3.2.1.2. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function. Also include those responsible for performing and documenting the inspections required by the International Codes and the special inspection program developed by the designer of record.

3.2.1.3. A copy of the letter to the CQC System Manager, signed by an authorized official of the firm, which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Furnish copies of these letters.

3.2.1.4. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect engineers (AE), offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

3.2.1.5. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. Use only Government approved Laboratory facilities.

3.2.1.6. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

3.2.1.7. Procedures for tracking design and construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

3.2.1.8. Reporting procedures, including proposed reporting formats.

3.2.1.9. A list of the definable features of work. A definable feature of work is a task, which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

3.2.1.10. A list of all inspections required by the International Codes and the special inspection program required by the code and this contract.

### 3.2.2. Additional Requirements for Design Quality Control (DQC) Plan

The following additional requirements apply to the Design Quality Control (DQC) plan:

3.2.2.1. The Contractor's QCP Plan shall provide and maintain a Design Quality Control (DQC) Plan as an effective quality control program which will assure that all services required by this design-build contract are performed and provided in a manner that meets professional architectural and engineering quality standards. As a minimum, competent, independent reviewers identified in the DQC Plan shall review all documents. Use personnel who were not involved in the design effort to produce the design to perform the independent technical review (ITR). The ITR is intended as a quality control check of the design. Include, at least, but not necessarily limited to, a review of the contract requirements (the accepted contract or task order proposal and amended RFP), the basis of design, design calculations, the design configuration management documentation and check the design documents for

errors, omissions, and for coordination and design integration. The ITR team is not required to examine, compare or comment concerning alternate design solutions but should concentrate on ensuring that the design meets the contract requirements. Correct errors and deficiencies in the design documents prior to submitting them to the Government.

3.2.2.2. Include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists at each design phase as part of the project documentation.

3.2.2.3. A Design Quality Control Manager, who has the responsibility of being cognizant of and assuring that all documents on the project have been coordinated, shall implement the DQC Plan. This individual shall be a person who has verifiable engineering or architectural design experience and is a registered professional engineer or architect. Notify the Government, in writing, of the name of the individual, and the name of an alternate person assigned to the position.

### 3.2.3. Acceptance of Plan

Government acceptance of the Contractor's plan is required prior to the start of design and construction. Acceptance is conditional and will be predicated on satisfactory performance during the design and construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

### 3.2.4. Notification of Changes

After acceptance of the CQC Plan, notify the Government in writing of any proposed change. Proposed changes are subject to Government acceptance.

## 3.3. COORDINATION MEETING

After the Postaward Conference, before start of design or construction, and prior to acceptance by the Government of the CQC Plan, the Contractor and the Government shall meet and discuss the Contractor's quality control system. Submit the CQC Plan for review a minimum of 7 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, design activities, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. The Government will prepare minutes of the meeting for signature by both parties. . The minutes shall become a part of the contract file. There may be occasions when either party will call for subsequent conferences to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

## 3.4. QUALITY CONTROL ORGANIZATION

### 3.4.1. Personnel Requirements

The requirements for the CQC organization are a CQC System Manager, a Design Quality Manager, and sufficient number of additional qualified personnel to ensure contract compliance. The CQC organization shall also include personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly furnish complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

### 3.4.2. CQC System Manager

Identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System

Manager shall be a graduate engineer, graduate architect, or a BA/BS graduate of an ACCE accredited construction management college program. The CQC system Manager may alternately be an engineering technician with at least 2 years of college and an ICC certification as a Commercial Building Inspector (Residential Building Inspector certification will be required for Military Family Housing projects). In addition, the CQC system manager shall have a minimum of 5 years construction experience on construction similar to this contract. The CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. Assign the CQC System Manager no other duties (except may also serve as Safety and Health Officer, if qualified and if allowed by Section 00 73 00). Identify an alternate for the CQC System Manager in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager but the alternate may have other duties in addition to serving in a temporary capacity as the acting QC manager.

#### 3.4.3. CQC Personnel

3.4.3.1. In addition to CQC personnel specified elsewhere in the contract provide specialized CQC personnel to assist the CQC System Manager in accordance with paragraph titled Area Qualifications.

3.4.3.2. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; **are not intended to be full time, but must be physically present at the construction site during work on their areas of responsibility**; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan. **One person may cover more than one area, provided that they are qualified to perform QC activities for the designated areas below and provided that they have adequate time to perform their duties:**

#### 3.4.4. Experience Matrix

##### 3.4.4.1. Area Qualifications

3.4.4.1.1. Civil - Graduate Civil Engineer or (BA/BS) graduate in construction management with 4 years experience in the type of work being performed on this project or engineering technician with 5 yrs related experience.

3.4.4.1.2. Mechanical - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Mechanical Inspector with 5 yrs related experience.

3.4.4.1.3. Electrical - Graduate Electrical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Electrical Inspector with 5 yrs related experience.

3.4.4.1.4. Structural - Graduate Structural Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or person with an ICC certification as a Reinforced Concrete Special Inspector and Structural Steel and Bolting Special Inspector (as applicable to the type of construction involved) with 5 yrs related experience.

3.4.4.1.5. Plumbing - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience, or person with an ICC certification as a Commercial Plumbing Inspector with 5 yrs related experience.

3.4.4.1.6. Concrete, Pavements and Soils Materials Technician (present while performing tests) with 2 yrs experience for the appropriate area

3.4.4.1.7. Testing, Adjusting and Balancing Specialist must be a member (TAB) Personnel of AABC or an experienced technician of the firm certified by the NEBB (present while testing, adjusting, balancing).

3.4.4.1.8. Design Quality Control Manager Registered Architect or Professional Engineer (not required on the construction site)

3.4.4.1.9. Registered Fire Protection Engineer with 4 years related experience or engineering technician with 5 yrs related experience (but see requirements for Fire Protection Engineer of Record to witness final testing in Section 01 10 00, paragraph 5.10, Fire Protection).

3.4.4.1.10. QC personnel assigned to the installation of the telecommunication system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification. In lieu of BICSI certification, QC personnel shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. QC personnel shall witness and certify the testing of telecommunications cabling and equipment.

#### 3.4.5. Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management for Contractors". This course is periodically offered at TBD. Inquire of the District or Division sponsoring the course for fees and other expenses involved, if any, for attendance at this course.

#### 3.4.6. Organizational Changes

When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

### 3.5. SUBMITTALS AND DELIVERABLES

Make submittals as specified in Section 01 33 00 **SUBMITTAL PROCEDURES**. The CQC organization shall certify that all submittals and deliverables are in compliance with the contract requirements.

### 3.6. CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. The CQC organization shall conduct at least three phases of control for each definable feature of the construction work as follows:

#### 3.6.1. Preparatory Phase

Perform this phase prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

3.6.1.1. A review of each paragraph of applicable specifications, reference codes, and standards. Make a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field at the preparatory inspection. Maintain these copies in the field, available for use by Government personnel until final acceptance of the work.

3.6.1.2. A review of the contract drawings.

3.6.1.3. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

3.6.1.4. Review of provisions that have been made to provide required control inspection and testing.

3.6.1.5. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

3.6.1.6. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

3.6.1.7. A review of the appropriate activity hazard analysis to assure safety requirements are met.



3.6.1.8. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

3.6.1.9. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

3.6.1.10. Discussion of the initial control phase.

3.6.1.11. Notify the Government at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

### 3.6.2. Initial Phase

Accomplish this phase at the beginning of a definable feature of work. Include the following actions:

3.6.2.1. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

3.6.2.2. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

3.6.2.3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

3.6.2.4. Resolve all differences.

3.6.2.5. Check safety to include compliance with and upgrading of the Accident Prevention plan and activity hazard analysis. Review the activity analysis with each worker.

3.6.2.6. Notify the Government at least 24 hours in advance of beginning the initial phase. The CQC System Manager shall prepare and attach to the daily CQC report separate minutes of this phase. Indicate exact location of initial phase for future reference and comparison with follow-up phases.

3.6.2.7. Repeat the initial phase any time acceptable specified quality standards are not being met.

### 3.6.3. Follow-up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Conduct final follow-up checks and correct deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

### 3.6.4. Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

## 3.7. TESTS

### 3.7.1. Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements and project design documents. Upon request, furnish to the Government

duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory, or establish an approved testing laboratory at the project site. The Contractor may elect to use a laboratory certified and accredited by the Concrete and cement Reference Laboratory (CCRL) or by AASHTO Materials Reference Laboratory (AMRL) for testing procedures that those organizations certify. The Contractor shall perform the following activities and record and provide the following data:

3.7.1.1. Verify that testing procedures comply with contract requirements and project design documents.

3.7.1.2. Verify that facilities and testing equipment are available and comply with testing standards.

3.7.1.3. Check test instrument calibration data against certified standards.

3.7.1.4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

3.7.1.5. Include results of all tests taken, both passing and failing tests, recorded on the CQC report for the date taken. Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

### 3.7.2. Testing Laboratories

#### 3.7.2.1. Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

#### 3.7.2.2. Capability Recheck

If the selected laboratory fails the capability check, the Government will assess the Contractor a charge of \$1,375 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

#### 3.7.3. Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

#### 3.7.4. Furnishing or Transportation of Samples for Government Quality Assurance Testing

The Contractor is responsible for costs incidental to the transportation of samples or materials. Deliver samples of materials for test verification and acceptance testing by the Government to the Corps of Engineers Laboratory, f.o.b., at the following address:

- For delivery by mail:
  - N/A
  - N/A
  - N/A
  - N/A
- For other deliveries:
  - N/A

N/A

N/A

N/A

The area or resident office will coordinate, exact delivery location, and dates for each specific test.

### 3.8. COMPLETION INSPECTION

#### 3.8.1. Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. Prepare a punch list of items which do not conform to the approved drawings and specifications and include in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

#### 3.8.2. Pre-Final Inspection

As soon as practicable after the notification above, the Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Correct any items noted on the Pre-Final inspection in a timely manner. Accomplish these inspections and any deficiency corrections required by this paragraph within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

#### 3.8.3. Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall attend the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups and major commands may also attend. The Government will formally schedule the final acceptance inspection based upon results of the Pre-Final inspection. Provide notice to the Government at least 14 days prior to the final acceptance inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

### 3.9. DOCUMENTATION

3.9.1. Maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers using government-provided software, QCS (see Section 01 45 01.10). The report includes, as a minimum, the following information:

3.9.1.1. Contractor/subcontractor and their area of responsibility.

3.9.1.2. Operating plant/equipment with hours worked, idle, or down for repair.

3.9.1.3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

- 3.9.1.4. Test and/or control activities performed with results and references to specifications/drawings requirements. Identify the applicable control phase (Preparatory, Initial, Follow-up). List deficiencies noted, along with corrective action.
- 3.9.1.5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- 3.9.1.6. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.
- 3.9.1.7. Offsite surveillance activities, including actions taken.
- 3.9.1.8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- 3.9.1.9. Instructions given/received and conflicts in plans and/or specifications.
- 3.9.1.10. Provide documentation of design quality control activities. For independent design reviews, provide, as a minimum, identity of the ITR team, the ITR review comments, responses and the record of resolution of the comments.
- 3.9.2. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. Furnish the original and one copy of these records in report form to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, submit one report for every 7 days of no work and on the last day of a no work period. Account for all calendar days throughout the life of the contract. The first report following a day of no work shall be for that day only. The CQC System Manager shall sign and date reports. The report shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel. The Contractor may submit these forms electronically, in lieu of hard copy.

### 3.10. NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

End of Section 01 45 04.00 10

**SECTION 01 50 02  
TEMPORARY CONSTRUCTION FACILITIES**

**1.0 OVERVIEW**

- 1.1. GENERAL REQUIREMENTS
- 1.2. AVAILABILITY AND USE OF UTILITY SERVICES
- 1.3. BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN
- 1.4. PROTECTION AND MAINTENANCE OF TRAFFIC
- 1.5. MAINTENANCE OF CONSTRUCTION SITE

## 1.0 OVERVIEW

### 1.1. GENERAL REQUIREMENTS

#### 1.1.1. Site Plan

Prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Also indicate if the use of a supplemental or other staging area is desired.

### 1.2. AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1. See Section 00 72 00, Contract Clauses and Section 00 73 00, Special Contract Requirements, for Utility Availability requirements.

#### 1.2.2. Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

#### 1.2.3. Telephone

Make arrangements and pay all costs for desired telephone facilities.

### 1.3. BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

#### 1.3.1. Bulletin Board

Immediately upon beginning of onsite work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Display legible copies of the aforementioned data until work is completed. Remove the bulletin board from the site upon completion of the project.

#### 1.3.2. Project and Safety Signs

Erect a project sign and a site safety sign with informational details as provided by the Government at the Post award conference, within 15 days prior to any work activity on project site. Update the safety sign data daily, with light colored metallic or non-metallic numerals. Remove the signs from the site upon completion of the project. Engineer Pamphlet EP 310-1-6a contains the standardized layout and construction details for the signs. It can be found through a GOOGLE Search or try <http://www.usace.army.mil/publications/eng-pamphlets/ep310-1-6a/s-16.pdf>.

### 1.4. PROTECTION AND MAINTENANCE OF TRAFFIC

Provide access and temporary relocated roads as necessary to maintain traffic. Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Take measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property.

The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. Investigate the adequacy of existing roads and the allowable load limit on these roads. Repair any damage to roads caused by construction operations.

#### 1.4.1. Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Construct haul roads with suitable grades and widths. Avoid sharp curves, blind corners, and dangerous cross traffic. Provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Contracting Officer. Provide adequate lighting to assure full and clear visibility for full width of haul road and work areas during any night work operations. Remove haul roads designated by the Contracting Officer upon completion of the work and restore those areas.

#### 1.4.2. Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

#### 1.5. MAINTENANCE OF CONSTRUCTION SITE

Mow grass and vegetation located within the boundaries of the construction site for the duration of the project, from NTP to contract completion. Edge or neatly trim grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers from NTP to contract completion.

End of Section 01 50 02

**SECTION 01 57 20.00 10  
ENVIRONMENTAL PROTECTION**

**1.0 GENERAL REQUIREMENTS**

- 1.1. SUBCONTRACTORS
- 1.2. ENVIRONMENTAL PROTECTION PLAN
- 1.3. PROTECTION FEATURES
- 1.4. ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS
- 1.5. NOTIFICATION

**2.0 PRODUCTS (NOT USED)**

**3.0 EXECUTION**

- 3.1. LAND RESOURCES
- 3.2. WATER RESOURCES
- 3.3. AIR RESOURCES
- 3.4. CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL
- 3.5. RECYCLING AND WASTE MINIMIZATION
- 3.6. HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES
- 3.7. BIOLOGICAL RESOURCES
- 3.8. INTEGRATED PEST MANAGEMENT
- 3.9. PREVIOUSLY USED EQUIPMENT
- 3.10. MILITARY MUNITIONS
- 3.11. TRAINING OF CONTRACTOR PERSONNEL
- 3.12. POST CONSTRUCTION CLEANUP



## 1.0 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of construction operations. Protect the environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire duration of this contract. Comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations

### 1.1. SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

### 1.2. ENVIRONMENTAL PROTECTION PLAN

1.2.1. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Define issues of concern within the Environmental Protection Plan as outlined in this section. Address each topic in the plan at a level of detail commensurate with the environmental issue and required construction task(s). Identify and discuss topics or issues which are not identified in this section, but which the Contractor considers necessary, after those items formally identified in this section. Prior to commencing construction activities or delivery of materials to the site, submit the Plan for review and Government approval. The Contractor shall meet with the Government prior to implementation of the Environmental Protection Plan, for the purpose of discussing the implementation of the initial plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. Maintain and keep the Environmental Protection Plan current onsite.

#### 1.2.2. Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

#### 1.2.3. Contents

The plan shall include, but shall not be limited to, the following:

1.2.3.1. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

1.2.3.2. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable

1.2.3.3. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel

1.2.3.4. Description of the Contractor's environmental protection personnel training program

1.2.3.5. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. Include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

1.2.3.6. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site

1.2.3.7. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

1.2.3.8. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

1.2.3.9. Drawing showing the location of on-installation borrow areas.

1.2.3.10. A spill control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The spill control plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:

- (a) The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Government and the local Fire Department in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.
- (b) The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup
- (c) Training requirements for Contractor's personnel and methods of accomplishing the training
- (d) A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.
- (e) The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency
- (f) The methods and procedures to be used for expeditious contaminant cleanup

1.2.3.11. A solid waste management plan identifying waste minimization, collection, and disposals methods, waste streams (type and quantity), and locations for solid waste diversion/disposal including clearing debris and C&D waste that is diverted (salvaged, reused, or recycled). Detail the contractor's actions to comply with, and to participate in, Federal, state, regional, local government, and installation sponsored recycling programs to reduce the volume of solid waste at the source. Identify any subcontractors responsible for the transportation, salvage and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility. Attach evidence of the facility's ability to accept the solid waste to this plan. A construction and demolition waste management plan, similar to the plan specified in the UFGS 01 74 19 (formerly 01572) may be used as the non-hazardous solid waste management plan. Provide a Non-Hazardous Solid Waste Diversion Report. Submit the report on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and each quarter thereafter (e.g. the first working day of January, April, July, and October) until the end of the project. Additionally, a summary report, with all data fields, is required at the end of the project. The report shall indicate the total type and amount of waste generated, total type and amount of waste diverted, type and amount of waste sent to waste-to-energy facility and alternative daily cover, in tons along with the percent that was diverted. Maintain, track and report construction and demolition waste data in a manner such that the installation can enter the data into the Army SWAR database, which separates data by type of material. A cumulative report in LEED Letter Template format may be used but must be modified to include the date disposed of/diverted and include the above stated diversion data. NOTE: The Solid Waste Diversion Reports are separate documentation than the LEED documentation.

1.2.3.12. DELETED.

1.2.3.13. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

1.2.3.14. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of

these materials. In accordance with EM 385-1-1, include a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time in the contaminant prevention plan. Update the plan as new hazardous materials are brought on site or removed from the site. Reference this plan in the storm water pollution prevention plan, as applicable.

1.2.3.15. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented and any required permits. If surface discharge will be the method of disposal, include a copy of the permit and associated documents as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, include documentation that the waste water treatment plant Operator has approved the flow rate, volume, and type of discharge.

1.2.3.16. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. Include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Government.

1.2.3.17. A pesticide treatment plan, updated, as information becomes available. Include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Installation specific requirements. Follow AR 200-1, Chapter 5, Pest Management, Section 5-4, "Program Requirements" for data required to be reported to the Installation.

### 1.3. PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Government shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. Both the Contractor and the Government will sign this survey, upon mutual agreement as to its accuracy and completeness. The Contractor develop a plan that depicts how it will protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

### 1.4. ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the Government and may require an extended review, processing, and approval time. The Government reserves the right to disapprove alternate methods, even if they are more cost effective, if the Government determines that the proposed alternate method will have an adverse environmental impact.

### 1.5. NOTIFICATION

The Government will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Government of the proposed corrective action and take such action when approved by the Government. The Government may issue an order stopping all or part of the

work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Government may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

## **2.0 PRODUCTS (NOT USED)**

## **3.0 EXECUTION**

### **3.1. LAND RESOURCES**

Confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. Do not attach or fasten any ropes, cables, or guys to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Remove all stone, soil, or other materials displaced into uncleared areas..

#### **3.1.1. Work Area Limits**

Prior to commencing construction activities, mark the areas that need not be disturbed under this contract. Mark or fence isolated areas within the general work area which are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. Personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

#### **3.1.2. Landscape**

Clearly identify trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved by marking, fencing, or wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

#### **3.1.3. Erosion and Sediment Controls**

Provide erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. Coordinate with approving authorities (federal, state, etc.) for specific requirements to be included in the plan. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. Keep the area of bare soil exposed at any one time by construction operations to a minimum necessary. Construct or install temporary and permanent erosion and sediment control best management practices (BMPs). BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Remove any temporary measures after the area has been stabilized.

#### **3.1.4. Contractor Facilities and Work Areas**

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Government. Make only approved temporary movement or relocation of Contractor facilities. Provide erosion and sediment controls for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Control temporary excavation and embankments for plant and/or work areas to protect adjacent areas.

### **3.2. WATER RESOURCES**

Monitor construction activities to prevent pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. Monitor all water areas affected by construction activities. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by state or federally issued Clean Water Act permits.

### 3.2.1. Stream Crossings

Stream crossings shall allow movement of materials or equipment without violating water pollution control standards of the Federal, State, and local governments or impede state-designated flows.

### 3.2.2. Wetlands

Do not enter, disturb, destroy, or allow discharge of contaminants into any wetlands.

## 3.3. AIR RESOURCES

Comply with all Federal and State air emission and performance laws and standards for equipment operation, activities, or processes.

### 3.3.1. Particulates

Control dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants, including weekends, holidays and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods are permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with all State and local visibility regulations.

### 3.3.2. Odors

Control odors from construction activities at all times. Odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

### 3.3.3. Sound Intrusions

Keep construction activities under surveillance and control to minimize environment damage by noise. Comply with the provisions of the state and Installation rules.

### 3.3.4. Burning

Burning is not allowed on the project site unless specified in other sections of the specifications or by written authorization. Specific times, locations, and manners of burning shall be subject to approval.

## 3.4. CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

### 3.4.1. Solid Wastes

Place solid wastes (excluding clearing debris) in containers which are emptied on a regular schedule. Conduct handling, storage, and disposal to prevent contamination. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with solid waste. Transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. The minimum acceptable off-site solid waste disposal option is a Subtitle D RCRA permitted landfill. Verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate. Comply with Federal, State, and local laws and regulations pertaining to the use of landfill areas.

### 3.4.2. Chemicals and Chemical Wastes

Dispense chemicals, ensuring no spillage to the ground or water. Perform and document periodic inspections of dispensing areas to identify leakage and initiate corrective action. The Government may periodically review this documentation. Collect chemical waste in corrosion resistant, compatible containers. Monitor and remove collection drums to a staging or storage area when contents are within 6 inches of the top. Classify, manage, store, and dispose of wastes in accordance with Federal, State, and local laws and regulations.

#### 3.4.3. Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable state and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. At a minimum, manage and store hazardous waste in compliance with 40 CFR 262. Take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. Segregate hazardous waste from other materials and wastes; protect it from the weather by placing it in a safe covered location and take precautionary measures, such as berming or other appropriate measures, against accidental spillage. Store, describe, package, label, mark, and placard hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, state, and local laws and regulations. Transport Contractor generated hazardous waste off Government property in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. Dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Immediately report spills of hazardous or toxic materials to the Government and the Facility Environmental Office. Contractor will be responsible for cleanup and cleanup costs due to spills. Contractor is responsible for the disposition of Contractor generated hazardous waste and excess hazardous materials.

#### 3.4.4. Fuel and Lubricants

Conduct storage, fueling and lubrication of equipment and motor vehicles in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with all Federal, State, Regional, and local laws and regulations.

### 3.5. RECYCLING AND WASTE MINIMIZATION

Participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project. Line and berm fueling areas and establish storm water control structures at discharge points for site run-off. Keep a liquid containment clean-up kit available at the fueling area.

### 3.6. HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Existing historical, archaeological, and cultural resources within the Contractor's work area are shown on the drawings. Protect and preserve these resources during the life of the Contract. Temporarily suspend all activities that may damage or alter such resources, if any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found during excavation or other construction activities. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, notify the Government so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. Cease all activities that may result in impact to or the destruction of these resources. Secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

### 3.7. BIOLOGICAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants, including their habitat. Protect threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

### 3.8. INTEGRATED PEST MANAGEMENT

Coordinate, through the Government, with the Installation Pest Management Coordinator (IPMC) at the earliest possible time prior to pesticide application, in order to minimize impacts to existing fauna and flora. Discuss

integrated pest management strategies with the IPMC and receive concurrence from the IPMC, through the COR, prior to the application of any pesticide associated with these specifications. Give IMPC personnel the opportunity to be present at all meetings concerning treatment measures for pest or disease control and during application of the pesticide. The use and management of pesticides are regulated under 40 CFR 152 - 186.

#### 3.8.1. Pesticide Delivery and Storage

Deliver pesticides, approved for use on the Installation, to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

#### 3.8.2. Qualifications

Use the services of a subcontractor for pesticide application whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed.

#### 3.8.3. Pesticide Handling Requirements

Formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions.

#### 3.8.4. Application

A state certified pesticide applicator shall apply pesticides in accordance with EPA label restrictions and recommendations.

### 3.9. PREVIOUSLY USED EQUIPMENT

Clean all previously used construction equipment prior to bringing it onto the project site. Ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the USDA jurisdictional office for additional cleaning requirements.

### 3.10. MILITARY MUNITIONS

Immediately stop work in that area and immediately inform the Government, in the event military munitions, as defined in 40 CFR 260, are discovered or uncovered.

### 3.11. TRAINING OF CONTRACTOR PERSONNEL

Train personnel in all phases of environmental protection and pollution control. Conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Conduct additional meetings for new personnel and when site conditions change. The training and meeting agenda shall include methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

### 3.12. POST CONSTRUCTION CLEANUP

Clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. Grade, fill and seed the entire disturbed area, unless otherwise indicated.

**SECTION 01 62 35  
RECYCLED/RECOVERED MATERIAL**

**1.0 GENERAL**

1.1. REFERENCES

1.2. OBJECTIVES

1.3. EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

1.4. EPA PROPOSED ITEMS INCORPORATED IN THE WORK

1.5. EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK



## 1.0 GENERAL

### 1.1. REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

- U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
- 40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

### 1.2. OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

### 1.3. EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials, when incorporated into the work under this contract, shall contain at least the minimum percentage of recycled or recovered materials indicated by EPA unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

### 1.4. EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

### 1.5. EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be use by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

End of Section 01 62 35

**SECTION 01 78 02.00 10  
CLOSEOUT SUBMITTALS**

**1.0 OVERVIEW**

- 1.1. SUBMITTALS
- 1.2. PROJECT RECORD DOCUMENTS
- 1.3. EQUIPMENT DATA
- 1.4. CONSTRUCTION WARRANTY MANAGEMENT
- 1.5. MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING
- 1.6. OPERATION AND MAINTENANCE MANUALS
- 1.7. FIELD TRAINING
- 1.8. PRICING OF CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY
- 1.9. LEED REVIEW MEETINGS
- 1.10. RED ZONE MEETING
- 1.11. FINAL CLEANING
- 1.12. INTERIM FORM DD1354 "TRANSFER AND ACCEPTANCE OF MILITARY REAL PROPERTY"

**EXHIBIT 1 SAMPLE RED ZONE MEETING CHECKLIST**

## 1.0 OVERVIEW

### 1.1. SUBMITTALS

Government approval is required for any submittals with a "G" designation; submittals not having a "G" designation are for Designer of Record approval or for information only. Submit the following in accordance with Section 01 33 00 submittals:

#### SD-02 Shop Drawings

- As-Built Drawings - G
  - Drawings showing final as-built conditions of the project. Provide electronic drawing files as specified in Section 01 33 16, 3 sets of blue-line prints and one set of the approved working as-built drawings.

#### SD-03 Product Data

- As-Built Record of Equipment and Materials
  - Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.
- Construction Warranty Management Plan
  - Three sets of the construction warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.
- Warranty Tags
  - Two record copies of the warranty tags showing the layout and design.
- Final Cleaning
  - Two copies of the listing of completed final clean-up items.

### 1.2. PROJECT RECORD DOCUMENTS

#### 1.2.1. As-Built Drawings – G

An as-built drawing is a construction drawing revised to reflect the final as-built conditions of the project as a result of modifications and corrections to the project design required during construction. The final as-built drawings shall not have the appearance of marked up drawings, but that of professionally prepared drawings as if they were the "as designed" drawings.

#### 1.2.2. Maintenance of As-Built Drawings

1.2.2.1. The Configuration Management Plan shall describe how the Contractor will maintain up-to-date drawings, how it will control and designate revisions to the drawings and specifications (In accordance with Special Contract Requirement: ***Deviating from the Accepted Design*** and Section 01 33 16: ***Design after Award***, the Designer of Record's approval is necessary for any revisions to the accepted design).

1.2.2.2. Make timely updates, carefully maintaining a record set of working as-built drawings at the job site, marked in red, of all changes and corrections from the construction drawings. Enter changes and corrections on drawings promptly to reflect "Current Construction". Perform this update no less frequently than weekly for the blue line drawings and update no less frequently than quarterly for the CADD/CAD and BIM files, which were prepared previously in accordance with Section 01 33 16. Include a confirmation that the as-builts are up to date with the submission of the monthly project schedule.

1.2.2.3. If the DB Contractor fails to maintain the as-built drawings as required herein, the Government will retain from the monthly progress payment, an amount representing the estimated monthly cost of maintaining the as-built drawings. Final payment with respect to separately priced facilities or the contract as a whole will be withheld until the Contractor submits acceptable as-built drawings and the Government approves them.

1.2.2.4. The marked-up set of drawings shall reflect any changes, alterations, adjustments or modifications. Changes must be reflected on all sheets affected by the change. Changes shall include marking the drawings to reflect structural details, foundation layouts, equipment sizes, and other extensions of design.

1.2.2.5. Typically, room numbers shown on the drawings are selected for design convenience and do not represent the actual numbers intended for use by the end user. Final as-built drawings shall reflect actual room numbers adopted by the end user.

1.2.2.6. If there is no separate contract line item (CLIN) for as-built drawings, the Government will withhold the amount of \$35,000, or 1% of the present construction value, whichever is the greater, until the final as-built drawing submittal has been approved by the Government.

### 1.2.3. Underground Utilities

The drawings shall indicate, in addition to all changes and corrections, the actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Locate Valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Record average elevation of the top of each run or underground structure..

### 1.2.4. Partial Occupancy

For projects where portions of construction are to be occupied or activated before overall project completion, including portions of utility systems, supply as-built drawings for those portions of the facility being occupied or activated at the time the facility is occupied or activated. Show this same as-built information previously furnished on the final set of as-built drawings.

### 1.2.5. As-Built Conditions That are Different From the construction Drawings

Accurately reflect all as-built conditions that are different, such as dimensions, road alignments and grades, and drainage and elevations, from the construction drawings on each drawing. If the as-built condition is accurately reflected on a shop drawing, then furnish that shop drawing in CADD format. Reference the final as-built construction drawing the shop drawing file that includes the as-built information. In turn, the shop drawing shall reference the applicable construction as-built drawing. Delete any options shown on drawings and not selected clearly reflect options selected on final as-built drawings.

### 1.2.6. Additional As-Built Information that Exceeds the Detail Shown on the construction Drawings:

These as-built conditions include those that reflect structural details, foundation layouts, equipment, sizes, mechanical and electrical room layouts and other extensions of design, that were not shown in the project design documents because the exact details were not known until after the time of approved shop drawings. It is recognized that these shop drawing submittals (revised showing as-built conditions) will serve as the as-built record without actual incorporation into the construction drawings, piping, and equipment drawings. Include locations of all explorations, logs of all explorations, and results of all laboratory testing, including those provided by the Government. Furnish all such shop drawings in CADD /CADformat. Include fire protection details, such as wiring, performed for the design of the project.

### 1.2.7. Final As-Built Drawings

Submit final as-built CADD/CAD and BIM Model(s) and Facility Data files at the time of Beneficial Occupancy of the project or at a designated phase of the project. In the event the Contractor accomplishes additional work after this submittal, which changes the as-built conditions, submit a new DVD with all drawing sheets and three blue-line copies of affected sheets which depict additional changes.

### 1.2.8. Title Blocks

In accordance with the configuration management plan, clearly mark title blocks to indicate final as-built drawings.

### 1.2.9. Other As-Built Documents

Provide scans of all other documents such as design analysis, catalog cuts, certification documents that are not available in native electronic format in an organized manner in Adobe.pdf format.

#### 1.2.9.1. LEED Documentation

Update LEED documentation on at least a monthly basis and have it available for review by the Government on the jobsite at all times during construction. Submit the final LEED Project Checklist(s), final LEED submittals checklist and complete project documentation, verifying the final LEED score and establishing the final rating. Provide full support to the validation review process, including credit audits. See also the LEED documentation requirements in Section 01 33 16, DESIGN AFTER AWARD.

#### 1.2.9.2. GIS Documentation

Provide final geo-referenced GIS database of the new building footprint along with any changes made to exterior of the building. The intent of capturing the final building footprint and exterior modifications in a GIS database is to provide the installation with a data set of the comprehensive changes made to the landscape as a result of the construction project. The Government will incorporate this data set into the installations existing GIS MasterPlan or Enterprise GIS system. The GIS database deliverable shall follow a standard template provided to the Contractor by the Government, adhere to detailed specifications outlined in ECB No 2006-15, and be documented using the Federal Geographic Data Committee (FGDC) metadata standard.

### 1.3. EQUIPMENT DATA

#### 1.3.1. Real Property Equipment

Provide an Equipment-in-Place list of all installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. Include the cost of each piece of installed property F.O.B. construction site. For each of the items which is specified herein to be guaranteed for a specified period from the date of acceptance thereof, provide the following information: The name, serial and model number address of equipment supplier, or manufacturer originating the guaranteed item. The Contractor's guarantee to the Government of these items will not be limited by the terms of any manufacturer's guarantee to the Contractor. Furnish the list as one (1) reproducible and three (3) copies thirty (30) calendar days before completion of any segment of the contract work which has an incremental completion date.

#### 1.3.2. Maintenance and Parts Data

Furnish a brochure, catalog cut, parts list, manufacturer's data sheet or other publication showing detailed parts data on all other equipment subject to repair and maintenance procedures not otherwise required in Operations and Maintenance Manuals specified elsewhere in this contract. Distribution of directives shall follow the same requirements as listed in paragraph above.

#### 1.3.3. Construction Specifications

Furnish permanent electronic files of final as-built construction specifications, including modifications thereto, with the as-built drawings.

### 1.4. CONSTRUCTION WARRANTY MANAGEMENT

1.4.1. Prior to the end of the one year warranty, the Government may conduct an infrared roof survey on any project involving a membrane roofing system. This survey will be conducted in accordance with ASTM C1153-90, "Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging". The Contractor shall replace all damaged materials and locate and repair sources of moisture penetration.

## 1.4.2. Management

### 1.4.2.1. Warranty Management Plan

Develop a warranty management plan containing information relevant to the clause **Warranty of Construction** in FAR 52.246-21. Submit the warranty management plan for Government approval at least 30 days before the planned pre-warranty conference. In the event of phased turn-over of the contract, update the Warranty Management Plan as necessary to include latest information required. Include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Submit warranty information made available during the construction phase prior to each monthly pay estimate. Assemble information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. The Contractor, Government, including the Customer Representative shall jointly conduct warranty inspections, 4 months and 9 months, after acceptance. The warranty management plan shall include, but shall not be limited to, the following information:

- (1) Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the contractors, subcontractors, manufacturers or suppliers involved.
- (2) Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.
- (3) A list for each warranted equipment, item, feature of construction or system indicating:
  - (i) Name of item.
  - (ii) Model and serial numbers.
  - (iii) Location where installed.
  - (iv) Name and phone numbers of manufacturers or suppliers.
  - (v) Names, addresses and telephone numbers of sources of spare parts.
  - (vi) Warranties and terms of warranty. Include one-year overall warranty of construction. Indicate those items, which have extended warranties with separate warranty expiration dates.
  - (vii) Cross-reference to warranty certificates as applicable.
  - (viii) Starting point and duration of warranty period.
  - (ix) Summary of maintenance procedures required to continue the warranty in force.
  - (x) Cross-reference to specific pertinent Operation and Maintenance manuals.
  - (xi) Organization, names and phone numbers of persons to call for warranty service.
  - (xii) Typical response time and repair time expected for various warranted equipment.
- (4) The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.
- (5) Procedure and status of tagging of all equipment covered by extended warranties.
- (6) Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

## 1.4.3. Performance Bond

1.4.3.1. The Contractor's Performance Bond will remain effective throughout the construction warranty period.

1.4.3.2. In the event the Contractor or his designated representative(s) fails to commence and diligently pursue any work required under this clause, and in a manner pursuant to the requirements thereof, the Government shall have

a right to demand that said work be performed under the Performance Bond by making written notice on the surety. If the surety fails or refuses to perform the obligation it assumed under the Performance Bond, the Government shall have the work performed by others, and after completion of the work, may make demand for reimbursement of any or all expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

1.4.3.3. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Government will have the right to recoup expenses from the bonding company.

1.4.3.4. Following oral or written notification of required warranty repair work, the Contractor will respond as dictated by para. 1.4.5. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Government to proceed against the Contractor as outlined in the paragraph 1.4.5.5 and/or above.

#### 1.4.4. Pre-Warranty Conference

Prior to contract completion, or completion of any phase or portion of contract to be turned over, and at a time designated by the Contracting Officer, the Contractor shall meet with the Government to develop a mutual understanding with respect to the requirements of this clause. Communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Government for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor will furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, will be continuously available, and will be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of his responsibilities in connection with other portions of this provision.

#### 1.4.5. Contractor's Response to Warranty Service Requirements.

Following Government oral or written notification, which may include authorized installation maintenance personnel, the Contractor shall respond to warranty service requirements in accordance with the "Warranty Service Priority List" and the three categories of priorities listed below. Submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframe specified, the Government will perform the work and backcharge the construction warranty payment item established.

1.4.5.1. First Priority Code 1 Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

1.4.5.2. Second Priority Code 2 Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

1.4.5.3. Third Priority Code 3 All other work to be initiated within 3 work days and work continuously to completion or relief.

1.4.5.4. The "Warranty Service Priority List" is as follows:

- Code 1 - Air Conditioning System
  - (a) Buildings with computer equipment.
  - (b) Barracks, mess halls (entire building down).
- Code 2 - Air Conditioning Systems
  - (a) Recreational support.
  - (b) Air conditioning leak in part of building, if causing damage.
  - (c) Air conditioning system not cooling properly

- (d) Admin buildings with Automated Data Processing (ADP) equipment not on priority list.
  - Code 1 - Doors
- (a) Overhead doors not operational.
  - Code 1 - Electrical
- (a) Power failure (entire area or any building operational after 1600 hours).
- (b) Traffic control devices.
- (c) Security lights.
- (d) Smoke detectors and fire alarm systems
- (e) Power or lighting failure to an area, facility, portion of a facility, which may adversely impact health, safety, security, or the installation's mission requirement, or which may result in damage to property.
  - Code 2 - Electrical
- (a) Power failure (no power) for unoccupied buildings or portions thereof or branch circuits within occupied buildings, not listed as Code 1.
- (a) Receptacle and lights, not listed as code 1.
  - Code 3 - Electrical
- (a) Street, parking area lights
  - Code 1 - Gas
- (a) Leaks and breaks.
- (b) No gas to cantonment area.
  - Code 1 - Heat
- (a) Area power failure affecting heat.
- (b) Heater in unit not working.
  - Code 2 Heat
- (a) All heating system failures not listed as Code 1.
  - Code 3 - Interior
- (a) Floor damage
- (b) Paint chipping or peeling
  - Code 1 - Intrusion Detection Systems - N/A.
  - Code 2 - Intrusion Detection Systems other than those listed under Code 1
  - Code 1 - Kitchen Equipment
- (a) Dishwasher.
- (b) All other equipment hampering preparation of a meal.
  - Code 2 - Kitchen Equipment
- (a) All other equipment not listed under Code 1.
  - Code 2 - Plumbing
- (a) Flush valves not operating properly
- (b) Fixture drain, supply line commode, or water pipe leaking.
- (c) Commode leaking at base.
  - Code 3 - Plumbing
- (a) Leaking faucets



- Code 1 - Refrigeration
  - (a) Mess Hall.
  - (b) Medical storage.
- Code 2 - Refrigeration
  - (a) Mess hall - other than walk-in refrigerators and freezers.
- Code 1 - Roof Leaks
  - (a) Temporary repairs will be made where major damage to property is occurring.
- Code 2 - Roof Leaks
  - (a) Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.
- Code 1 - Sprinkler System
  - (a) All sprinkler systems, valves, manholes, deluge systems, and air systems to sprinklers.
- Code 1 - Tank Wash Racks (Bird Baths)
  - (a) All systems which prevent tank wash.
- Code 1 - Water (Exterior)
  - (a) Normal operation of water pump station.
- Code 2 - Water (Exterior)
  - (a) No water to facility.
- Code 1 - Water, Hot (and Steam)
  - (a) Barracks (entire building).
- Code 2 - Water, Hot
  - (a) No hot water in portion of building listed under Code 1

1.4.5.5. Should parts be required to complete the work and the parts are not immediately available, the Contractor shall have a maximum of 12 hours after arrival at the job site to provide the Government, with firm written proposals for emergency alternatives and temporary repairs for Government participation with the Contractor to provide emergency relief until the required parts are available on site for the Contractor to perform permanent warranty repair. The Contractor's proposals shall include a firm date and time that the required parts shall be available on site to complete the permanent warranty repair. The Government will evaluate the proposed alternatives and negotiate the alternative considered to be in the best interest of the Government to reduce the impact of the emergency condition. Alternatives considered by the Government will include the alternative for the Contractor to "Do Nothing" while waiting until the required parts are available to perform permanent warranty repair. Negotiating a proposal which will require Government participation and the expenditure of Government funds shall constitute a separate procurement action by the using service.

#### 1.4.6. Equipment Warranty Identification Tags

1.4.6.1. Provide warranty identification tags at the time of installation and prior to substantial completion shall provide warranty identification tags on all Contractor and Government furnished equipment which the Contractor has installed.

- (a) The tags shall be suitable for interior and exterior locations, resistant to solvents, abrasion, and to fading caused by sunlight, precipitation, etc. These tags shall have a permanent pressure-sensitive adhesive back, and they shall be installed in a position that is easily (or most easily) noticeable. Tag each component of contractor furnished equipment that has differing warranties on its components.
- (b) Submit sample tags, representing how the other tags will look, for Government review and approval.
- (c) Tags for Warranted Equipment: The tag for this equipment shall be similar to the following: Exact format and size will be as approved.

## MFG WARRANTY(IES) EXPIRE

## MFG WARRANTY(IES) EXPIRE

(d) If the manufacturer's name (MFG), model number and serial number are on the manufacturer's equipment data plate and this data plate is easily found and fully legible, this information need not be duplicated on the equipment warranty tag

1.4.6.2. Execution: Complete the required information on each tag and install these tags on the equipment by the time of and as a condition of final acceptance of the equipment.

## 1.5. MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Submit; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems prior to final inspection and transfer of the completed facility for approval, as specified in applicable technical specification sections.

## 1.6. OPERATION AND MAINTENANCE MANUALS

### 1.6.1. General Requirements

1.6.1.1. Inasmuch as the operations and maintenance manuals are required to operate and maintain the facility, the operations and maintenance (O&M) manuals will be considered a requirement prior to substantial completion of any facility to be turned over to the Government. Beneficial occupancy of all or portions of a facility prior to substantial completion will not relieve the Contractor of liquidated damages, if substantial completion exceeds the required completion date.

1.6.1.2. Provide one permanent electronic copy on CD-ROM and 2 hard copies of the Equipment Operating, Maintenance, and Repair Manuals. Provide separate manuals for each utility system as defined hereinafter. Submit Operations and Maintenance manuals for approval before field training or 90 days before substantial completion (whichever occurs earlier). If there is no separate CLIN for O&M Manuals, the Government will withhold an amount representing \$20,000, as non-progressed work, until submittal and approval of all O&M manuals are complete.

### 1.6.2. Definitions

#### 1.6.2.1. Equipment

A single piece of equipment operating alone or in conjunction with other equipment to accomplish a system function.

#### 1.6.2.2. System

A combination of one or more pieces of equipment which function together to accomplish an intended purpose (i.e. HVAC system is composed of many individual pieces of equipment such as fans, motors, compressors, valves, sensors, relays, etc.)

### 1.6.3. Hard Cover Binders

The manuals shall be hard cover with posts, or 3-ring binders, so sheets may be easily substituted. Print the following identification on the cover: the words "EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS," the project name, building number, and an indication of utility or systems covered, the name of the Contractor, and the Contract number. Manuals shall be approximately 8-1/2 by 11-inches with large sheets folded in and capable of being easily pulled out for reference. All manuals for the project must be similar in appearance, and be of professional quality.

### 1.6.4. Warning Page

Provide a warning page to warn of potential dangers (if they exist, such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, high pressures, etc.). Place the warning page inside the front cover and in front of the title page. Include any necessary Material Safety Data Sheets (MSDS) here.

### 1.6.5. Title Page

The title page shall include the same information shown on the cover and show the name of the preparing firm and the date of publication.

#### 1.6.6. Table of Contents

Each volume of the set of manuals for this project shall include a table of contents, for the entire set, broken down by volume.

#### 1.6.7. GENERAL

Organize manuals according to the following format, and include information for each item of equipment. Submit a draft outline and table of contents for approval at 50% contract completion.

#### TABLE OF CONTENTS

##### PART I: Introduction

- Equipment Description
- Functional Description
- Installation Description

##### PART II: Operating Principles

##### PART III: Safety

##### PART IV: Preventive Maintenance

- Preventive Maintenance Checklist, Lubrication
- Charts and Diagrams

##### PART V: Spare Parts Lists

- Troubleshooting Guide
- Adjustments
- Common Repairs and Parts Replacement

##### PART VI: Illustrations

#### 1.6.7.1. Part I-Introduction

Part I shall provide an introduction, equipment or system description, functional description and theory of operation, and installation instructions for each piece of equipment. Include complete instructions for uncrating, assembly, connection to the power source and pre-operating lubrication in the installation instructions as applicable. Illustrations, including wiring and cabling diagrams, are required as appropriate in this section. Include halftone pictures of the equipment in the introduction and equipment description, as well as system layout drawings with each item of equipment located and marked. Do not use copies of previously submitted shop drawings in these manuals.

#### 1.6.7.2. Part II-Operating Principles

Part II shall provide complete instructions for operating the system, and each piece of equipment. Illustrations, halftone pictures, tables, charts, procedures, and diagrams are required when applicable. This will include step-by-step procedures for start-up and shutdown of both the system and each component piece of equipments, as well as adjustments required to obtain optimum equipment performance, and corrective actions for malfunctions. Show performance sheets and graphs showing capacity data, efficiencies, electrical characteristics, pressure drops, and flow rates here, also. Marked-up catalogs or catalog pages do not satisfy this requirement. Present performance information as concisely as possible with only data pertaining to equipment actually installed. Include actual test data collected for Contractor performance here.

#### 1.6.7.3. Part III-Safety

Part III shall contain the general and specific safety requirements peculiar to each item of equipment. Repeat safety information as notes cautions and warnings in other sections where appropriate to operations described.

#### 1.6.7.4. Part IV-Preventive Maintenance

Part IV shall contain a troubleshooting guide, including detailed instructions for all common adjustments and alignment procedures, including a detailed maintenance schedule. Also include a diagnostic chart showing symptoms and solutions to problems. Include test hookups to determine the cause, special tools and test equipment, and methods for returning the equipment to operating conditions. Information may be in chart form or in tabular format with appropriate headings. Include instructions for the removal, disassembly, repair, reassembly, and replacement of parts and assemblies where applicable and the task is not obvious.

#### 1.6.7.5. Part V-Spare Parts List

Part V shall contain a tabulation of description data and parts location illustrations for all mechanical and electrical parts. The heading of the parts list shall clearly identify the supplier, purchase order number, and equipment. Include the unit price for each part. List parts by major assemblies, and arrange the listing in columnar form. Include names and addresses of the nearest manufacturer's representatives, as well as any special warranty information. Provide a list of spare parts that are recommended to be kept in stock by the Government installation.

#### 1.6.7.6. Part VI-Illustrations

Part VI shall contain assembly drawings for the complete equipment or system and for all major components. Include complete wiring diagrams and schematics. Other illustrations, such as exploded views, block diagrams, and cutaway drawings, are required as appropriate.

#### 1.6.8. Framed Instructions

Post framed instructions are required for substantial completion. Post framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, including equipment, ductwork, piping valves, dampers, and control sequence at a location near the equipment described. Prepare condensed operating instructions explaining preventive maintenance procedures methods of checking the system for normal safe operation, valve schedule and procedures for safely starting and stopping the system in type form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. Submit proposed diagrams, instructions, and other sheets prior to posting. Post the framed instructions before field training.

#### 1.6.9. (Reserved. See 1.7 for Field Training)

#### 1.6.10. System/Equipment Requirements

##### 1.6.10.1. Facility Heating System

Provide information on the following equipment: boilers, water treatment, chemical feed pumps and tanks, converters, heat exchangers, pumps, unit heaters, fin-tube radiation, air handling units (both heating only and heating and cooling), and valves (associated with heating systems).

##### 1.6.10.2. Air-Conditioning Systems

Provide information in chillers, packaged air-conditioning equipment, towers, water treatment, chemical feed pumps and tanks, air-cooled condensers, pumps, compressors, air handling units, and valves (associated with air-conditioning systems).

##### 1.6.10.3. Temperature Control and HVAC Distribution Systems

Provide all information described for the following equipment: valves, fans, air handling units, pumps, boilers, converters and heat exchangers, chillers, water cooled condensers, cooling towers, and fin-tube radiation, control air compressors, control components (sensors, controllers, adapters and actuators), and flow measuring equipment.

#### 1.6.10.4. Central Heating Plants

Provide the information described for the following equipment: boilers, converters, heat exchangers, pumps, fans, steam traps, pollution control equipment, chemical feed equipment, control systems, fuel handling equipment, de-aerators, tanks (flash, expansion, return waters, etc.), water softeners, and valves.

#### 1.6.10.5. Heating Distribution Systems

Provide the information described for the following equipment: valves, fans, pumps, converters and heat exchangers, steam traps, tanks (expansion, flash, etc.), and piping systems.

#### 1.6.10.6. Exterior Electrical Systems

Provide information on the following equipment: power transformers, relays, reclosers, breakers, and capacitor bank controls.

#### 1.6.10.7. Interior Electrical Systems

Provide information on the following equipment: relays, motor control centers, switchgear, solid state circuit breakers, motor controller, EPS lighting systems, wiring diagrams and troubleshooting flow chart on control systems, and special grounding systems.

#### 1.6.10.8. Energy Monitoring and Control Systems

The maintenance manual shall include descriptions of maintenance for all equipment, including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.

#### 1.6.10.9. Domestic Water Systems

Provide the identified information on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentation, laboratory test equipment, chemical feeders, valves, switching gear, and automatic controls.

#### 1.6.10.10. Wastewater Treatment Systems

Provide the identified information on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentations, laboratory test equipment chemical feeders, valves, scrapers, skimmers, comminutors, blowers, switching gear, and automatic controls.

#### 1.6.10.11. Fire Protection Systems

Provide information on the following equipment: alarm valves, manual valves, regulators, foam and gas storage tanks, piping materials, sprinkler heads, nozzles, pumps, and pump drivers.

#### 1.6.10.12. Fire Alarm and Detection Systems

- (1) The maintenance manual shall include description of maintenance for all equipment, including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
- (2) Provide all software; database with complete identification of programmable portions of system equipment and devices, and all other system programming data on all modes of the system; connecting cables; and proprietary equipment necessary for the operation, maintenance, testing, repair and programming, etc. of the system and that may be required for implementation of future changes to the fire system (additional and/or relocated initiating devices, notification devices, etc.
- (3) Provide all system and equipment technical data and computer software with the requisite rights to Government use, in accordance with the applicable contract clauses.
- (4) Training shall include software and programming required for the effective operation, maintenance, testing, diagnostics and expansion of the system.

#### 1.6.10.13. Plumbing Systems

Provide information on the following equipment: water heaters, valves, pressure regulators backflow preventors, piping materials, and plumbing fixtures.

#### 1.6.10.14. Liquid Fuels Systems

Provide information on the following equipment: tanks, automatic valves manual valves, filter separators, pumps, mechanical loading arms, nozzles, meters, electronic controls, electrical switch gear, and fluidic controls.

#### 1.6.10.15. Cathodic Protection Systems

Provide information on the following material and equipment: rectifiers, meters, anodes, anode backfill, anode lead wire, insulation material and wire size, automatic controls (if any), rheostats, switches, fuses and circuit breakers, type and size of rectifying elements, type of oil in oil-immersed rectifiers, and rating of shunts.

#### 1.6.10.16. Generator Installations

Provide information on the following equipment: generator sets, automatic transfer panels, governors, exciters, regulators starting systems, switchgear, and protective devices.

#### 1.6.10.17. Miscellaneous Systems

Provide information on the following: communication and ADP systems, security and intrusion alarm, elevators, material handling, active solar, photovoltaic, nurse call, paging, intercom, closed circuit TV, irrigation, sound and material delivery systems, kitchen, refrigeration, disposal, ice making equipment, and other similar type special systems not otherwise specified.

#### 1.6.10.18. Laboratory, Environmental and Pollution Control Systems

Provide information on the following equipment: wet scrubbers, quench chambers, scrub tanks, liquid oil separators, and fume hoods.

### 1.7. FIELD TRAINING

Field Training is a requirement for substantial completion. Conduct a training course for the operating staff for each particular system. Conduct the training is to be conducted during hours of normal working time after the system is functionally complete. The field instructions shall cover all of the items contained in the Equipment Operating, Maintenance and Repair Manuals. The training will include both classroom and "hands-on" training. Submit a lesson plan outlining the information to be discussed during training periods. Submit this lesson plan for approval 90 days before contract completion before the field training occurs. Record training on DVD and furnish to the Government within ten (10) days following training. Document all training and furnish a list of all attendees.

### 1.8. PRICING OF CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY

Promptly furnish and require any sub-contractor or supplier to furnish, in like manner, unit prices and descriptive data required by the Government for Property Record purposes of fixtures and equipment furnished and/or installed by the Contractor or sub-contractor, except prices do not need to be provided for Government-Furnished Property.

### 1.9. LEED REVIEW MEETINGS

1.9.1. Pre-Closeout Meeting. Approximately 30 days before submittal of LEED closeout documentation, the Contractor and the Government's project delivery team (including Installation representative) will meet to review the documentation, determine which, if any, credits will be audited and identify any corrections/missing items prior to the closeout LEED documentation submittal.

1.9.2. Approximately 14 days after submittal of LEED closeout documentation, the Contractor and the Government's project delivery team (including Installation representative) will meet to review the LEED closeout

documentation. The review conference will include discussion of and resolution of all review comments to ensure consensus on achievement of credits and satisfactory documentation. At the review conference a final score will be determined and endorsed in writing by all parties.

#### 1.10. RED ZONE MEETING

At approximately 80% of contract completion or 60 days before the anticipated Beneficial Occupancy Date (BOD), whichever occurs first, the Contractor and the Government's project delivery team will conduct what is known as the Red Zone Meeting to discuss the close-out process, to schedule the events and review responsibilities for actions necessary to produce a timely physical, as well as fiscal, project close-out. The Red Zone meeting derives its name from the football term used to describe the team effort to move the ball the last 20 yards into the end zone. The close-out of a construction project sometimes can be equally as hard and most definitely requires the whole team's efforts. The ACO will chair the meeting. If not already provided, shortly before the meeting, the Contractor shall provide an electronic copy or access to the CADD as-built drawings, completed commensurate with the amount of work completed at the time of the Red Zone Meeting, as an indicator of the Contractors' understanding of and ability to meet the USACE CADD Standards and to ensure that the Contractor is making progress with CADD As-Built requirements. EXHIBIT 1 is a generic meeting checklist.

#### 1.11. FINAL CLEANING

Clean the premises in accordance with FAR clause 52.236-12 and additional requirements stated here. Remove stains, foreign substances, and temporary labels from surfaces. Vacuum carpet and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean or replace filters of operating equipment if cleaning isn't possible or practicable. Remove debris from roofs, drainage systems, gutters, and downspouts. Sweep paved areas and rake clean landscaped areas. Remove waste, surplus materials, and rubbish from the site. Remove all temporary structures, barricades, project signs, fences and construction facilities. Submit a list of completed clean-up items on the day of final inspection.

#### 1.12. INTERIM FORM DD1354 "TRANSFER AND ACCEPTANCE OF MILITARY REAL PROPERTY

Near the completion of Project, but a minimum of 60 days prior to final acceptance of the work, complete, update draft provided with the final design package(s) (see Section 01 33 16, paragraph 3.7.5) and submit an accounting of all installed property on Interim Form DD1354 "Transfer and Acceptance of Military Real Property." Include any additional assets/improvements/alterations and cost updates from the Draft DD Form 1354. Contact the COR for any project specific information necessary to complete the DD Form 1354. This form will be a topic for the Red Zone Meeting discussed above. For information purposes, a blank DD Form 1354 (fill-able) in ADOBE (PDF) may be obtained at the following web site: <http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd1354.pdf> Submit the completed Checklist for Form DD1354 of Government-Furnished and Contractor-Furnished/Contractor Installed items. Attach this list to the updated DD Form 1354. Instructions for completing the form and a blank checklist (fill-able) in ADOBE (PDF) may be obtained at the following web site: [http://www.wbdg.org/ccb/DOD/UFC/ufc\\_1\\_300\\_08.pdf](http://www.wbdg.org/ccb/DOD/UFC/ufc_1_300_08.pdf)



EXHIBIT 1

**SAMPLE**

Red Zone Meeting Checklist

**Date:** \_\_\_\_\_

<b>Contract No.</b>	
<b>Description / Location</b>	
<b>Contractor</b>	
<b>Contracting Officer</b>	

<b>Action</b>	<b>Completion Milestone</b>	<b>√</b>
Inspections		
Fire		
Safety		
Pre-final		
Mechanical Test & Balance		
Commissioning		
Landscaping Complete		
Erosion Control		
Beneficial Occupancy Date (BOD)		
Furniture Installation		
Comm Installation		
As-Built Drawings		
Provide all O&M manuals, tools, shop drawings, spare parts, etc. to customer		
Training of O&M Personnel		
Provide Warranty documents to Customer		
Contract completion		

Ribbon cutting		
Payroll Clearances		
DD Form 2626 - Construction Contractor Performance Evaluation		
DD Form 2631 – A-E Performance Rated after Construction		
Status of Pending Mods and REA's/Claims		
Final Payment Completed		
Release of Claims		
Return of Unobligated Funds		
Move Project from CIP to General Ledger		
Financial completion		

End of Section 01 78 02.00 10

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX A

### Geotechnical Information

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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**PRELIMINARY  
GEOTECHNICAL ENGINEERING REPORT  
F22 HANGAR EXPANSION  
LANGLEY AIR FORCE BASE  
HAMPTON, VIRGINIA  
S&ME Project 1081-10-2718**

Prepared for:  
United States Corp of Engineers  
Norfolk, Virginia

Prepared by:  
S&ME, Inc.  
Richmond, Virginia

February 18, 2010



February 18, 2010

United States Army Corp. of Engineers  
803 Front Street  
Norfolk, Virginia 23510-1096

Attention: Marc Gutterman

**Reference: Preliminary Geotechnical Engineering Report**  
F-22 Hangar Expansion  
Langley Air Force Base  
Hampton, Virginia  
S&ME Project 1081-10-2718

Dear Mr. Gutterman:

This preliminary geotechnical engineering report presents the results of the subsurface exploration by S&ME, Inc. (S&ME) for the proposed F-22 Hangar Expansion at Langley Air Force Base in Hampton, Virginia. The purpose of this preliminary study was to obtain subsurface information at the project site to identify geotechnical factors that might impact future development. The information contained in this report might not be sufficient for final project design.

This report describes our understanding of the project, presents the results of the field explorations and laboratory testing, and discusses our preliminary geotechnical considerations. Part of our scope of services for the project involved environmental sampling and testing. While the environmental exploration and sampling portion of our work has been completed, to date, the results of the testing have not been received from our subcontracted laboratory. We will provide the results of the environmental testing under separate cover when received.

S&ME appreciates this opportunity to be of service to you. Please call if you have questions concerning this report or any of our services.

Respectfully submitted,

**S&ME, Inc. | Richmond Branch**

Alan F. Sweeney, EIT  
Staff Professional

Joseph A. Clarke, P.E.  
Geotechnical Engineer



AFS/JND/jac

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**Appendix I - Drawings**

**Appendix II – Records of Explorations**

**Appendix III – Laboratory Test Results**

## **1. AUTHORIZATION**

S&ME, Inc. (S&ME) is pleased to submit our Preliminary Geotechnical Engineering Report to the United States Army Corp of Engineers (USACE) for the proposed F-22 Hangar Expansion at Langley Air Force Base (AFB) in Hampton, Virginia. S&ME completed our services in accordance with:

- The Statement of Work (SOW) provided by the USACE on January 15, 2010,
- The USACE's Order for Supplies or Services signed on January 20, 2010,
- S&ME's Proposal for Preliminary Geotechnical Engineering and Environmental Sampling Services (PR09231, Revision 2) dated December 18, 2009.

## **2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT**

Based on the provided SOW, Langley AFB plans to expand an existing F-22 hangar (Building 361) located at 73 West Flight Line Road. We understand the existing building is supported on deep foundations. The proposed expansion will be located on the south portion of the existing structure. The project site is a relatively flat, grass-covered field with little topographic relief. A small drainage ditch running from the north to the south approximately bisects the site. On February 2, 2010, the USACE provided preliminary isolated column loads of approximately 100 to 150 kips for the structure. Drawing 1 in Appendix I indicates the general site vicinity of the project.

## **3. OBJECTIVE AND SCOPE**

The first objective of our geotechnical study was to explore subsurface conditions at the project site to identify recognized geotechnical factors that might impact future development. We expect this report will be used to support development of design-build contract documents during scoping of final design.

The second objective of our study was to investigate soil contamination in the upper eight feet of the expansion area at ten locations. As noted in the cover letter to this report, we will summarize the results of our environmental study under separate cover once testing results are finalized.

Our detailed scope of services is defined in our Proposal for Preliminary Geotechnical Engineering and Environmental Sampling Services (PR09231, Rev. 2) dated December 18, 2009. In summary, we executed the following general scope of services for the project:

- Staked boring locations at the project site and evaluated proposed drilling rig access.
- Drilled three Standard Penetration Test (SPT) borings to depths of 50 feet each and prepared logs of the explorations.
- Completed two Cone Penetrometer Test (CPT) soundings to depths of 50 feet each.



- Completed 10 geoprobes to depths ranging from 6 to 8 feet (for environmental sampling).
- Completed laboratory testing on selected samples recovered from the test borings to aid in the classification of onsite soils and to develop typical geotechnical engineering soil parameters for preliminary analysis.
- Prepared this preliminary report summarizing our evaluation of subsurface conditions and preliminary geotechnical recommendations as they relate to general site development.

The above services were used to develop this preliminary geotechnical engineering report, which is based on information available to us for the proposed development. The following services were not provided by S&ME: construction cost or quantity estimates, final geotechnical engineering design, analyses of potential stormwater management facilities, and preparation of detailed plans and specifications.

#### **4. FIELD EXPLORATIONS**

S&ME arranged a subsurface exploration program at the project site to collect subsurface data as part of our preliminary services for the F-22 Hangar Expansion project. Fishburne Drilling, Inc. of Chesapeake, Virginia completed three Standard Penetration Test (SPT) borings to depths of approximately 50 feet each on January 20, 2010. ConeTec of Charles City, Virginia completed two cone penetrometer test (CPT) soundings to depths of 50 feet each and 10 geoprobes to depths ranging from 6 to 8 feet on January 20, 2010. S&ME personnel monitored the explorations in the field and prepared logs of the test borings, CPT soundings, and geoprobes.

The test borings were completed using 2 7/8-inch-diameter mud rotary drilling techniques. Disturbed samples were obtained using Standard Penetration Test (SPT) methods with an automatic hammer in general accordance with ASTM D1586. The Standard Penetration Test provides a split-spoon sample of the tested soil and a resulting standard penetration resistance value, which gives an indication of the density or consistency of the in-place soils. Standard penetration resistance values can be utilized with empirical correlations to estimate physical properties and engineering characteristics for most soils. A more detailed explanation of the drilling and sampling method is also provided in Appendix II.

CPT soundings were performed by hydraulically advancing a 15 square-centimeter piezocone from a 20-ton, truck-mounted cone penetration rig. Cone data was captured using proprietary ConeTec software. Pore pressure measurements were measured with a pore pressure transducer located in the  $u_2$  position.

Exploration locations were determined in the field prior to the field event by S&ME and USACE personnel using existing site features for reference. Precision Measurements, Inc. surveyed the as-drilled exploration locations and surface elevations after completion of the field event. Approximate exploration locations are shown on Drawing 2 in Appendix I. Specific observations, remarks, and logs for the explorations prepared by S&ME are included in Appendix II.

## 5. LABORATORY TESTING

S&ME performed laboratory testing on disturbed jar samples and bulk samples of near-surface soils collected from our subsurface explorations. Testing was performed to aid in the classification of soils encountered in the test borings and to aid in the development of typical engineering parameters for encountered soils. Laboratory testing included the following:

- 12 Grain size analyses without hydrometer,
- 12 Atterberg Limits
- 19 Natural moisture contents
- 2 Modified Proctor moisture-density relationship tests
- 2 California Bearing Ratio (CBR) tests.

The laboratory tests were performed in general accordance with ASTM test methods. The results of the laboratory tests are presented in Appendix III.

## 6. SUBSURFACE CONDITIONS

The following sections contain a description of the geologic setting, the soils encountered during our subsurface exploration, and groundwater observations.

### 6.1 Site Geology

The project site is located in the Coastal Plain Physiographic Province. The Coastal Plain is characterized by unconsolidated marine to fluvial sediments, varying from clay to gravel, poorly to well sorted, with lateral variation in thickness, although generally increasing in thickness towards the east. Vertical variation within the geologic formations of the coastal plain is often controlled by cyclic sequences that fine or coarsen with depth, with formations separated by unconformities. Regionally, the stratigraphy of the coastal plain can be generalized as a wedge of sediments composed of fluvial and coastal plain sands and gravels of Quaternary and upper Tertiary age, underlain by marine, deltaic, and fluvial clays, silts, and sands of lower Tertiary age, underlain by fluvial-deltaic to shallow-shelf sands and clays of Cretaceous age, underlain by crystalline bedrock. Depth to bedrock varies from tens of feet near the western extent of the coastal plain at the Fall Line to over 3,000 feet near the coastline.

Locally, the site is underlain by the Lynnhaven Member of the Tabb Formation<sup>1</sup>. The Lynnhaven Member is comprised of clayey sand or sandy clay, coarsening with depth to a basal gravelly sand. Total thickness of the Lynnhaven Member is up to about eight feet within the project region, and directly overlies the blue-gray sand and sandy clay of the Yorktown Formation. Localized areas (in proximity to Tabb Creek or the Northwest

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<sup>1</sup> Johnson, Gerald H. 1976. Geology of the Mulberry Island, Newport News North, and Hampton Quadrangles, Virginia. [map 1:24000]. Virginia Department of Mineral Resources Report of Investigation 41.

Branch of the Back River) of the project area may have thin surficial deposits of peat and other organic matter.

## 6.2 Subsurface Summary

This section provides our interpretation of subsurface conditions encountered in the three test borings and two CPT soundings at the time of our exploration. Soils encountered at the project site generally consisted of the following:

- **Topsoil** was encountered in the three test borings with a measured thickness ranging from approximately 1.5 to 2 inches.
- **Suspected Fill** soils were observed in the upper 3 to 6 feet and generally consisted of medium dense to dense SAND (SC) with varying amounts of clay and gravel. Uncorrected Standard Penetration Test (SPT) N-values in the fill soils ranged from 11 blows per foot (bpf) to 35 bpf, with an average of 17 bpf.
- **Stratum 1** soils were observed underlying the suspected fill soils to a maximum depth of about 13 feet beneath existing ground surface. Stratum 1 soils consisted predominantly of very loose to loose SAND (SC, SM) with varying amounts of clay and silt. In some cases, Stratum 1 was interbedded with a 2-foot-thick layer of medium stiff lean CLAY (CL) with varying amounts of sand. Uncorrected SPT N-values in Stratum 1 ranged from 3 bpf to 8 bpf, with an average of 5 bpf.
- **Stratum 2** soils consisted of loose to medium dense SAND (SM) with varying amounts of silt. Uncorrected SPT N-values in Stratum 2 ranged from 6 bpf to 14 bpf, with an average of 8 bpf. Stratum 2 was observed beneath Stratum 1 and extended to the termination depth of the three borings (50 feet). The soils of Stratum 2 are indicative of the Yorktown Formation, in our opinion.

## 6.3 Subsurface Water Observations

Subsurface water was encountered at the time of our exploration in 11 of the 15 subsurface explorations completed for the F-22 Hangar Expansion project. A 1 ¼ inch-diameter hand-slotted PVC piezometer was installed in test boring 10B01 to a depth of about 18 feet to evaluate post-exploration water levels. Our observations are summarized in Table 1.

**Table 1 – Subsurface Water Observations**

Exploration Designation <sup>1</sup>	Approximate Exploration Surface Elevation (feet) <sup>2</sup>	Approximate Depth to Water (feet) <sup>3</sup>	Approximate Subsurface Water Elevation (feet) <sup>3</sup>
10B01 <sup>4</sup>	8	5	3
10B02	6	6	0
10B03	6.5	8	-1.5
10CPT01	8	6	2
10CPT02	7	8	-1

Exploration Designation <sup>1</sup>	Approximate Exploration Surface Elevation (feet) <sup>2</sup>	Approximate Depth to Water (feet) <sup>3</sup>	Approximate Subsurface Water Elevation (feet) <sup>3</sup>
10GP01	8	Not Encountered	---
10GP02	6	5.5	0.5
10GP03	6.5	Not Encountered	---
10GP04	6.5	5.5	1
10GP05	6.5	Not Encountered	---
10GP06	6.5	4.5	2
10GP07	6	4.5	1.5
10GP08	7	6.5	0.5
10GP09	7	Not Encountered	---
10GP10	6.5	5	1.5

<sup>1</sup> Refer to Drawing 2 in Appendix I for approximate boring locations.

<sup>2</sup> Approximated from Topographic Survey provided by USACE on February 12, 2010 and surveyed by Precision Measurements, Inc.

<sup>3</sup> Observed depth to water and water elevation rounded to the nearest ½-ft.

<sup>4</sup> A Piezometer was installed after boring completion to measure post-exploration subsurface water levels.

Note that subsurface water levels tend to fluctuate due to rainfall, season, temperature, site grading, and other factors that might differ those prevailing at the time S&ME completed the subsurface explorations.

#### 6.4 Preliminary Subsurface Profile

A preliminary subsurface profile in the vicinity of the explorations completed for the proposed F-22 Hangar Expansion is provided as Drawing 3 in Appendix I. Test boring and CPT sounding logs were projected onto a baseline selected by S&ME to create the profile. The baseline is shown on Drawing 2 in Appendix I. The preliminary subsurface profile shows soil type, SPT N-value, moisture content, and location of subsurface water as observed during drilling. The preliminary subsurface profile is meant for informational purposes only and does not depict interpreted stratum boundaries.

### 7. PRELIMINARY GEOTECHNICAL DESIGN RECOMMENDATIONS

Preliminary recommendations for foundations, floor slabs, pavements and seismic site classification are provided in the following sections. Note recommendations are preliminary and subject to the limitations set forth in Section 9 of this report.

#### 7.1 Foundations

This section provides preliminary recommendations for design of foundations at the project site. Location-specific subsurface conditions documented in our exploration logs should be reviewed and supplemented by additional explorations, if necessary, during final design.

### 7.1.1 *Shallow Foundations*

In our opinion, shallow foundations bearing on natural soils or controlled structural fill are a suitable method of support for the proposed structure. For planning purposes, we recommend a maximum allowable net bearing capacity for shallow spread footing design of 2,000 pounds per square foot (psf).

Foundation depth should be at least 18 inches below exterior finished grade for protection against freeze-thaw damage. We recommend a minimum footing width of 24 inches for wall foundations and 36 inches for isolated column foundations to prevent punching shear failure.

Results of our preliminary settlement analyses indicate column loads up to approximately 50 kips and wall loads up to approximately 4 kips per linear foot will result in total settlements of less than approximately one inch when founded on native soils or controlled structural fill (provided bearing pressures are limited to those shown above). The design-build geotechnical engineer should evaluate bearing capacity and settlement based on actual structural loads and subsurface parameters obtained from field and laboratory data

### 7.1.2 *Transitional Depth Foundations*

Heavily loaded foundations (i.e. greater than 50 kips) might require additional ground improvement or deep foundation support, in our opinion, to limit total settlements to approximately one inch or less.

Transitional depth foundations (between shallow and deep) can be used to reinforce the onsite soils to increase allowable bearing pressures and decrease settlement of shallow foundations. Examples of transitional depth foundations include rammed aggregate piers (Geopier Foundation Company), vibro replacement columns (Hayward Baker Inc.), or controlled modulus columns (DGI-Menard). Different construction methods for transitional depth foundations can be utilized to limit the generation of drill spoils (for environmentally contaminated sites) and construct the elements in caving soils below the water table. Shallow spread footings founded on surficial soils reinforced with one of the options mentioned above can typically be designed for 4,000 psf to 6,000 psf while limiting total settlements to less than approximately one inch.

### 7.1.3 *Deep Foundations*

Deep foundations, such as driven precast-concrete piles, steel pipe piles, or auger cast piles, are a few of the feasible foundation options that may be utilized to support heavily loaded foundations at the project site. Based on our observations in test borings 10B01 through 10B03 and cone penetrometer test soundings 10CPT01 and 10CPT02, no clear bearing stratum was identified within the depth of explorations. Thus, we anticipate deep foundation options will develop their capacity by a combination of friction and end bearing when driven into Stratum 2 (Yorktown Formation). Table 2 provides typical ranges of allowable vertical capacities ( $FS=2.5$ ) of various deep foundation options at the project site.

**Table 2 – Typical Deep Foundation Allowable Vertical Capacities**

Tip Depth (feet)	Tip Elevation (feet)	Typical Single-Pile Vertical Allowable Capacity (kips)					
		PCC		PP		ACIP	
		12-inch	16-inch	12-inch diameter	16-inch diameter	12-inch diameter	16-inch diameter
30	-25	25	45	10	25	15	25
40	-35	40	75	20	40	20	35
50	-45	65	115	35	65	25	45
Notes: 1. Tip elevation assumes an approximate ground surface elevation of approximately 8 feet and a bottom of pile cap at approximately El. 5. 2. FS=2.5 for vertical allowable capacity calculation. 3. PCC=Pre-cast Concrete pile, PP=Pipe pile (closed-end), ACIP=Auger Cast-in-Place pile							

## 7.2 Floor Slabs

Ground floor slabs may be supported on natural subgrade prepared in accordance with our recommendations in Section 8.2 or controlled structural fill and gravel base course. Based on our laboratory California Bearing Ratio (CBR) tests, a modulus of subgrade reaction,  $k$ , of 250 pounds per square inch per inch is indicative of the near surface material types encountered in our investigation compacted with Modified Proctor effort. Floor slabs should be damp-proofed in accordance with Section 1807 of the *International Building Code 2006 (IBC 2006)*. We recommend all floor slabs be underlain by a 4-inch-thick crushed stone base course, such as VDOT No. 57 stone, to provide a capillary moisture barrier, overlain by 6-mil-thick or greater polyethylene membrane per *IBC 2006* Section 1807.2.1 for damp-proofing.

## 7.3 Pavements

S&ME completed two laboratory CBR tests on bulk soil samples collected from borings 10B01 and 10B02 from a depth of 0 to 5 feet below the ground surface. The CBR tests were run using the ASTM D1883 methodology (utilizing Modified Proctor compaction energy). The tests resulted in CBR values of 34.3 and 83.1. We make the following general pavement recommendations:

- Pavement subgrade should be prepared in accordance with our recommendations in Section 8.2. Construction should be completed in accordance with the applicable military or local specifications.
- Design adequate grading to provide runoff away from paved surfaces and beyond the limits of paved areas and buildings. We recommend underdrains at low points in pavements to limit water penetration into the base course and subbase.
- The designer should confirm applicable CBR design values based on materials encountered within the project area.

## 7.4 Seismic Site Classification

We recommend the site be classified as Site Class D per the *2006 International Building Code (IBC 2006)* Section 1613.

S&ME evaluated the potential for liquefaction of the subsurface soils using the “Simplified Procedure” and corrected SPT N-values recorded during our subsurface exploration to determine the Cyclic Resistance Ratio (CRR). Seismic site data was obtained from the 2002 United States Geologic Survey (USGS) probabilistic hazard maps in order to estimate the peak ground acceleration in the event of an earthquake. Based on the results of our preliminary analysis, we judge that “catastrophic” liquefaction failure of the underlying soils is unlikely. However, we recommend further field explorations be performed by the contractor to investigate subsurface soil parameters and the potential for liquefaction before construction of the proposed F-22 Hangar Expansion.

Post-earthquake settlement of the underlying soils is possible in the event of a large, long-duration seismic event. This settlement would result from the densification of looser sandy soils. The design-builder should evaluate the potential and estimated magnitude of seismic induced settlement prior to final design.

## **8. PRELIMINARY EARTHWORK CONSIDERATIONS**

Earthwork considerations provided in the following sections are intended to serve as guidance to aid in the preparation of the project documents prior to release to selected design-build contractors. Geotechnical engineering considerations are based on information provided by the project team, the results of our preliminary subsurface exploration, laboratory test results, preliminary geotechnical analyses, and experience.

### **8.1 Excavation and Temporary Lateral Earth Support**

We anticipate excavation will be required for installation of utilities and construction of foundations. Soils encountered within anticipated excavation depths during our preliminary site investigation typically consisted of SAND with varying clay content (SC) and CLAY with varying amounts of sand (CL). We offer the following general recommendations with regards to excavation of onsite soils:

- For preliminary planning purposes, onsite soils might experience bulk volume shrinkage of approximately 15% from cuts to fills. This estimate of volume shrinkage does not account for the effects of topsoil and root mat removal in shallow, near-surface cuts, which might increase the bulk shrinkage.
- We expect the onsite soils can be excavated with conventional earth moving equipment. SPT N-values observed in the upper 10 feet in the preliminary test borings ranged from 3 to 35 blows per foot (bpf). We expect blasting will not be required.
- All excavations, including open excavation where shoring is not required, should be completed in accordance with applicable OSHA regulations.

Temporary lateral earth support might be required to facilitate utility installation and construction of foundation elements. Temporary shoring must be designed by the contractor to resist lateral earth pressures, water pressures, and adjacent construction, traffic, and other appropriate surcharge pressures. A qualified, Professional Engineer registered in the Commonwealth of Virginia must prepare shoring plans. The contractor

should be alerted that owner review of the planned shoring system may be required and that their calculations should be clearly documented.

## **8.2 Dewatering**

Subsurface water was measured in 11 of the preliminary subsurface explorations completed for the project at depths ranging from approximately 4 to 8 feet beneath existing grade. Additionally, subsurface water was measured in boring 10B01, approximately three weeks after installation of a 1.25 inch piezometer, at a depth of approximately 5 feet below the existing ground surface. Water levels may fluctuate from what we encountered during our investigation and our groundwater observations might not be adequate for the proper design of a dewatering system.

The site is in close proximity to the southwest branch of the Back River. The design-build team should evaluate the impact of tidal waters on the proposed construction. Tidal effects from the adjacent river may result in water levels that change with time.

The final dewatering approach must be developed based on site conditions at the time of construction. We recommend all excavation, concrete work, and placement of utilities be conducted “in-the-dry.” We recommend the Contractor be required to select a dewatering system capable of maintaining the piezometric water level at least two feet below the bottom of the excavation at all times, providing dry conditions with stable subgrade. A qualified, Professional Engineer registered in Virginia should prepare dewatering plans. The contractor should be alerted that review of the dewatering plan may be required and that their calculations be clearly documented.

## **8.3 Undercut Potential**

The project site for the F-22 Hangar Expansion is a relatively flat grass field with an existing hangar to the north and a road surrounding the remainder of the site. Topsoil thicknesses ranged from 1½ to 2 inches across the site.

Suspected fill was observed to depths up to six feet beneath existing grade. Previously placed fill soils will likely be encountered during site grading and excavation operations. Fill is inherently variable in nature and unexpected conditions may be encountered. Unexpected conditions may consist of low-consistency fill soils, debris-laden fill with significant voids, or organics. Any unexpected conditions encountered on the site can be addressed by engineering evaluations during construction.

Undercut of soft and/or wet soils may be required during construction. Typically, repair of weak or unstable subgrade soils can be accomplished by one of the following alternatives: (1) compacting soils in-place using a vibratory drum roller or other compaction equipment, (2) scarifying, moisture conditioning and recompacting in-place, (3) undercutting and replacement with suitable structural fill, or (4) use of geosynthetics, or some combination of these. Lime treatment of soils with excessive moisture may help to stabilize the subgrade. The repair method chosen will depend on actual conditions in the field at the time of construction; therefore, the repair method selection should be made by a representative of the Government at the time of subgrade evaluation.



## 8.4 Subgrade Preparation

Generally, interbedded fine- and coarse-grained soils were encountered within the upper ten feet at the site. We expect sandy soils can typically be moisture conditioned and compacted in place with limited difficulty to provide stable subgrade. However, fine-grained soils and sands with high clay content are relatively impermeable and easily disturbed by wet weather and construction traffic. Ponding of water on the ground surface may occur after periods of precipitation. Protection and drainage of the subgrade soils during construction will be required to promote stable subgrade.

In general, we recommend the following activities take place prior to placement of controlled structural fill, pavement, foundations, or utilities. These activities should be detailed in the project documents.

1. Strip all pavements, organic materials, debris and other detrimental material from the surface. Remove heavy root mat and stumps (if encountered in the fill); hair-like roots may be left in place.
2. Remove subsurface structures and debris that interfere with required compaction.
3. Proofroll final soil subgrade with appropriate equipment approved by the Government Engineer. Areas that exhibit instability due to high, near surface moisture content may be scarified and worked until the proper level of moisture is obtained to achieve compaction in accordance with the project documents. Subgrade soils that exhibit continual failure should be stabilized per the recommendations in Section 8.3. A representative of the Government should make recommendations for a suitable working platform before placing controlled structural fill or pavement base material.
4. Construction access roads should be managed to minimize incidental traffic across final subgrade. All subgrade to receive additional fill, structures, or pavements should be sloped to drain to protect subgrade from distress that could be caused by excessive wetting. Repair damaged subgrade in accordance with the Project requirements.

## 8.5 Controlled Structural Fill

We offer our preliminary recommendations for controlled structural fill in the following sections. We provide considerations for materials, imported fill, the suitability of onsite soils for reuse as controlled structural fill, and compaction.

### 8.5.1 Material Considerations

Inorganic, onsite soils with less than 40% passing the No. 200 sieve and a Plasticity Index of less than 25% are suitable for reuse as controlled structural fill. Soils with greater than 40% passing the No. 200 sieve with a Liquid Limit less than 50% are also acceptable as controlled structural fill, however will be difficult to moisture condition and compact as recommended. Soils with a Liquid Limit greater than 50% are not suitable for reuse as controlled structural fill within the upper four feet beneath building and paved areas.

### 8.5.2 *Imported Fill*

Imported fill or off-site borrow should conform to the requirements described in Section 8.5.1. The Government Engineer should approve off-site borrow soils prior to placement as controlled structural fill. Off-site borrow should arrive at the site near optimum moisture content to facilitate compaction.

### 8.5.3 *Reuse of Onsite Soils*

Generally, sand with varying clay and silt content (SC, SM) and lean clay with varying sand content (CL) were observed within the upper 10 feet at the project site. Onsite soils available from cut areas may be used as fill/backfill where the criteria in Section 8.5.1 is met. As such, we expect that:

- The onsite granular soils are typically well-suited for reuse as controlled structural fill.
- The contractor should plan to segregate desirable from undesirable sources of controlled structural fill during site work.
- Additional laboratory testing might be required during construction to evaluate the suitability of onsite materials for reuse as controlled structural fill.

To aid in the decision to use onsite soils as controlled structural fill, S&ME performed two Modified Proctor compaction tests on soils encountered within the upper 5 feet at the project site. The test results are provided in Appendix III. Based on moisture content test results in the upper 10 feet at the site, the in-situ moisture content of the soils at the time of sampling was approximately 4% to 24% wetter than the optimum moisture content for compaction for the samples tested. The final approach for moisture conditioning (adding or removing water) of the soil should be based on conditions encountered in the field at the time of construction.

Soils with greater than 50% passing the No. 200 sieve are generally more sensitive to moisture conditioning than granular soils and might require more time to place properly if they have moisture contents significantly higher or lower than the optimum moisture content. We suggest that the contractor research the cost benefit of using such soils as controlled structural fill with respect to his schedule, the amount of effort required to properly prepare the soils, and the availability of suitable onsite and off-site soils based on final grading plans.

### 8.5.4 *Compaction Requirements*

Contract Provisions should be developed such that the Contractor should:

1. In areas supporting structures, slab on grade, or pavement, place controlled structural fill in horizontal, loose lifts not exceeding 8 inches in thickness. Compact controlled structural fill to at least 95% of maximum dry density per Modified Proctor (ASTM D1557). Control moisture content within 3% of the optimum moisture content per Modified Proctor (ASTM D1557) or as approved by the Government Engineer.

2. Place controlled structural fill only in the presence of a qualified representative of the Government. Allow the Government's representative opportunity to field test controlled structural fill for dry density in accordance with either the sand cone method (ASTM D1556) or the nuclear method (ASTM D6938).
3. Do not place fill through water or on snow, ice, or frozen subgrade.
4. Backfill utility trenches within pavement areas or below floor slabs with controlled structural fill or dense-graded aggregate such as VDOT No. 21A, No. 21B or No. 10 sand screenings. Compact trench backfill in maximum 6-inch lifts to at least 95% of the maximum dry density as determined by the Modified Proctor test (ASTM D1557).

## **9. LIMITATIONS**

This Preliminary Geotechnical Engineering Report has been prepared for the exclusive use of the United State Army Corp of Engineers for specific application to the proposed F-22 Hangar Expansion, at Langley Air Force base in Hampton, Virginia. This report is preliminary and was prepared to support development of design-build contract documents and as preliminary information to design-build teams. The conclusions contained in this report are preliminary and are not adequate for final design.

This report has been prepared in accordance with generally accepted geotechnical engineering practices. No other warranty, express or implied, is made. Our conclusions and recommendations are based, in part, on the information on subsurface conditions available to us at this time. No construction plans have been made available as of the writing of this report. Variations in both the nature and extent of the subsurface conditions could be observed in additional explorations completed during design and/or during construction.

Standard test methods are referenced in this report. Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

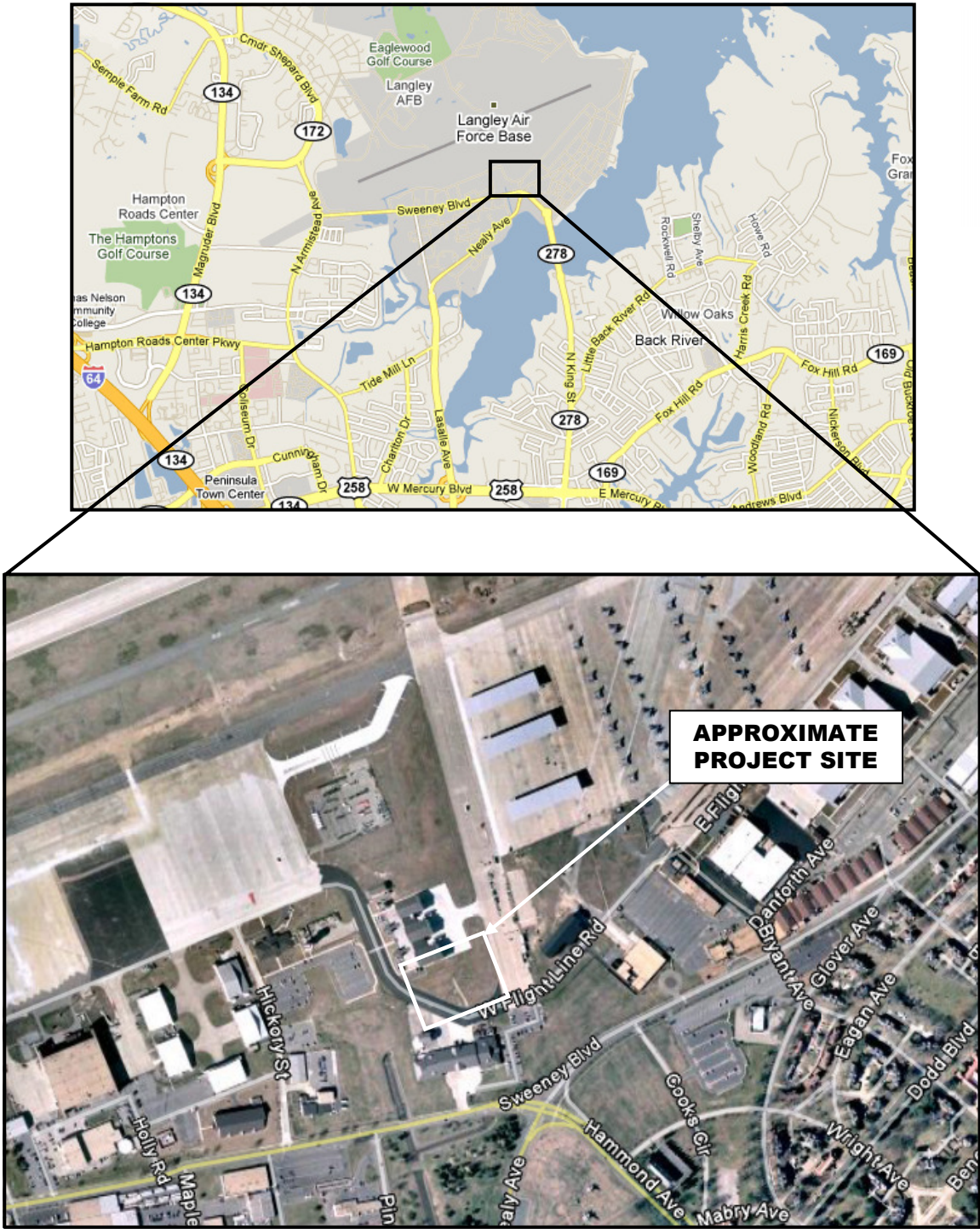


## **APPENDIX I - DRAWINGS**


DRAWING 1– Site Vicinity Map

DRAWING 2 –Approximate Subsurface Exploration Location Plan

DRAWING 3 – Subsurface Profile Baseline A-A'



NOTE:  
UPPER MAP CREATED USING GOOGLE MAPS.  
LOWER MAP CREATED USING GOOGLE  
EARTH.

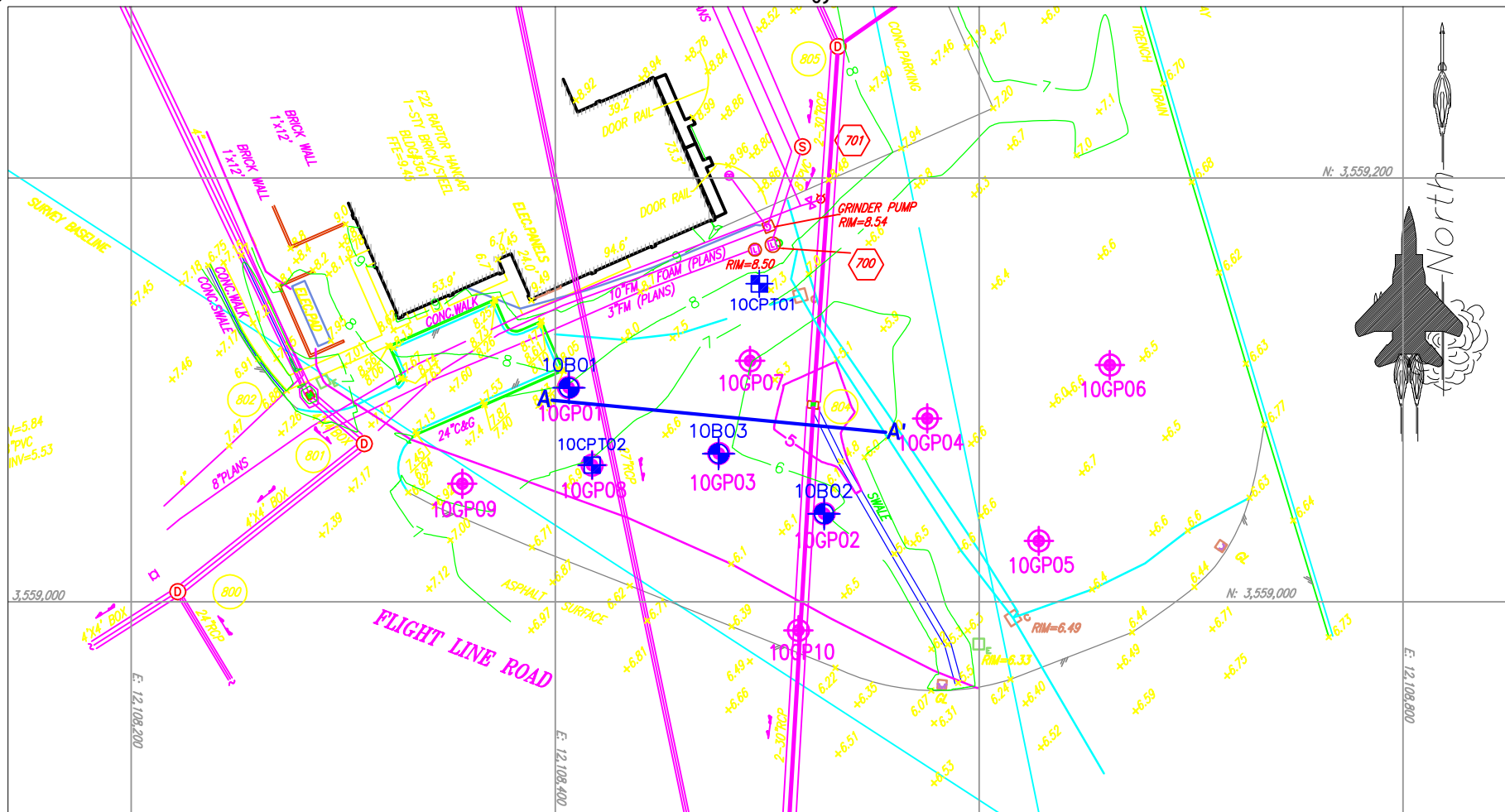


1081-10-2718  
F-22 HANGAR EXPANSION  
LANGLEY AIR FORCE BASE  
HAMPTON, VIRGINIA

SITE VICINITY MAP

PREPARED BY:	REVIEWED BY:	DRAWING  1
DRAFTER: AFS	SCALE: NONE	





NOTES:

1. THE BASE PLAN FOR THIS DRAWING WAS PROVIDED BY THE USACE ON FEBRUARY 12, 2010.
2. CONETEC OF CHARLES CITY, VIRGINIA COMPLETED TWO CONE PENETRATION TEST (CPT) SOUNDINGS AND TEN GEOPROBES (GP) AND FISHBURNE DRILLING, INC. OF CHESAPEAKE, VIRGINIA COMPLETED THREE STANDARD PENETRATION TEST (SPT) BORINGS AT THE PROJECT SITE ON JANUARY 20, 2010. S&ME PERSONNEL MONITORED THE EXPLORATIONS IN THE FIELD AND PREPARED LOGS OF THE TEST BORINGS AND GEOPROBES.
3. LOCATIONS OF THE SUBSURFACE EXPLORATIONS SHOWN ON THE DRAWING ARE APPROXIMATE AND WERE SURVEYED BY PRECISION MEASUREMENTS AFTER S&ME COMPLETED THE FIELD EXPLORATIONS.

- 10B01 STANDARD PENETRATION TEST (SPT) BORING DESIGNATION AND APPROXIMATE LOCATION.
- 10CPT01 CONE PENETRATION TEST (CPT) SOUNDINGS DESIGNATION AND APPROXIMATE LOCATION.
- 10GP07 GEOPROBE (GP) DESIGNATION AND APPROXIMATE LOCATION.

SCALE:  
AS SHOWN

PROJECT NO.  
1081-10-2718

DATE:  
FEB. 2010

DRAWN BY:  
AFS

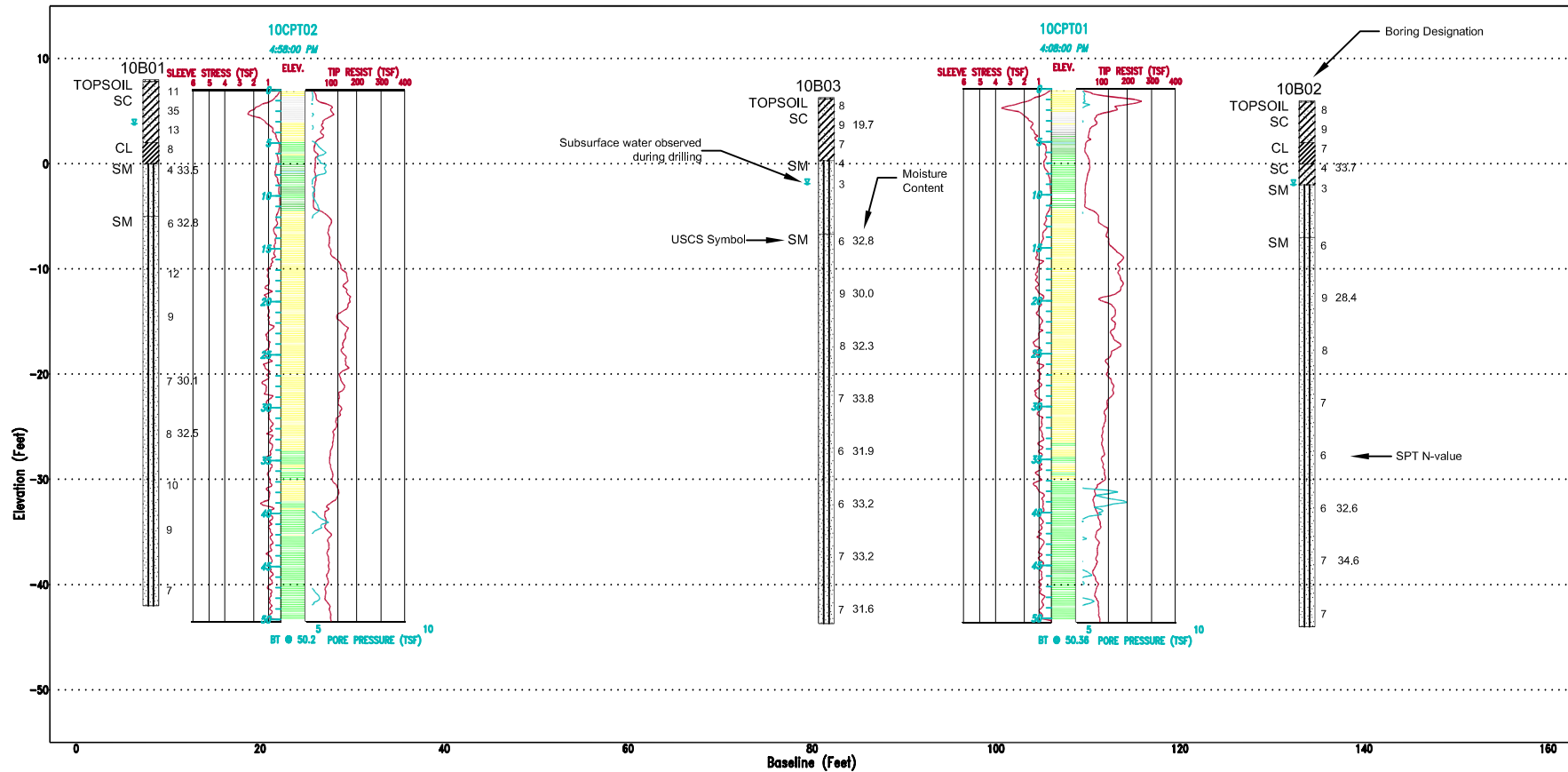
CHECKED BY:



APPROXIMATE SUBSURFACE  
EXPLORATION LOCATION PLAN  
F-22 HANGAR EXPANSION  
LANGLEY AFB, HAMPTON, VIRGINIA

DRAWING

2



## NOTES:

1. THE STANDARD PENETRATION TEST (SPT) BORINGS AND CONE PENETROMETER TEST (CPT) SOUNDINGS SHOWN ON THIS SUBSURFACE PROFILE WERE COMPLETED BY S&ME AS PART OF THE F-22 HANGAR EXPANSION AT LANGLEY AFB IN HAMPTON, VIRGINIA. REFER TO DRAWING 2 FOR AN APPROXIMATE SUBSURFACE EXPLORATION PLAN AND DEPICTION OF THE CROSS SECTION BASELINE.
2. THE SUBSURFACE PROFILE SHOWN ON THIS DRAWING DEPICTS SUBSURFACE CONDITIONS AS OBSERVED AT THE EXPLORATION LOCATIONS AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MIGHT VARY BETWEEN EXPLORATION LOCATIONS AND MIGHT DIFFER FROM WHAT WE OBSERVED AT THE TIME OF DRILLING.
3. LOCATIONS OF THE SUBSURFACE EXPLORATIONS SHOWN ON THIS DRAWING ARE APPROXIMATE AND WERE PROJECTED ONTO A BASELINE SELECTED BY S&ME AS ILLUSTRATED ON DRAWING 2. SUBSURFACE LOCATIONS WERE SURVEYED BY PRECISION MEASUREMENTS AFTER S&ME COMPLETED THE FIELD EXPLORATIONS.
4. THIS SUBSURFACE PROFILE IS MEANT FOR INFORMATIONAL PURPOSES ONLY AND MAY NOT PROVIDE SUFFICIENT INFORMATION TO SUCCESSFULLY BID, DESIGN, OR CONSTRUCT THE PROPOSED STRUCTURE.

SCALE:

AS SHOWN

DATE:

FEB.2010

PROJECT NO.

1081-10-2717

DRAWN BY:

AFS

CHECKED BY:



SUBSURFACE PROFILE  
 BASELINE A - A'  
 F-22 HANGAR EXPANSION  
 LANGLEY AFB, HAMPTON, VIRGINIA

DRAWING

3



## **APPENDIX II – RECORDS OF EXPLORATIONS**

Logs of Test Borings (10B01 – 10B03, 10GP01 – 10GP10, 10CPT01 and 10CPT02)

USACE Key to Coarse-Grained Soil Classification

USACE Key to Fine-Grained Soil Classification

Key to USCS Terminology and Graphic Symbols

Direct Rotary Drilling and Sampling Method



DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 2 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 2 7/8" Roller Bit			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,101.1 E 12,108,406.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY Fishburne Drilling, Inc.				12. MANUFACTURER'S DESIGNATION OF DRILL CME 550X ATV			
4. HOLE NO. (As shown on drawing title and file number) 10B01				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 13 UNDISTURBED 0	
5. NAME OF DRILLER Tim Donahue				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 50.0				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+8.0 ±	
9. TOTAL DEPTH OF HOLE 50.0				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST Alan Sweeney, EIT			
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
7.83	0.2		Topsoil	0' to 2'	5-5-6-5 N=11	Topsoil thickness = 2 inches Laboratory Sample No. 16926	
			[SC] Medium dense, brown, fine to coarse SAND, with some clay, moist.	2' to 4'	15-18-17-13 N=35	1 inch of gravel in spoon tip	
			[SC] Dense, brown, fine to coarse SAND, with some clay and trace gravel, moist.	4' to 6'	13-8-5-5 N=13	A bulk sample was collected from a depth of approximately 0 to 5 feet beneath the existing ground surface.	
2	6.0		[CL] Firm, orange-brown mottled with gray, Sandy lean CLAY, moist.	6' to 8'	5-4-4-4 N=8	FILL	
0	8.0		[SM] Loose, orange-brown mottled with gray, fine to medium SAND, with little silt, wet.	8' to 10'	3-2-2-2 N=4	Laboratory Sample No. 16927	
-5	13.0		[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	13' to 15'	4-3-3-3 N=6	STRATUM 1 Switched to mud rotary drilling techniques. Trace shell fragments observed in sample. Laboratory Sample No. 16928	
			[SM] Medium dense, green-gray, fine to medium SAND, with little silt, wet.	18' to 20'	5-5-7-8 N=12	Trace shell fragments observed in sample.	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	23' to 25'	5-4-5-7 N=9	Trace shell fragments observed in sample.	
						STRATUM 2 - YORKTOWN	


DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 2 OF 2 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 2 7/8" Roller Bit			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,101.1 E 12,108,406.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY Fishburne Drilling, Inc.				12. MANUFACTURER'S DESIGNATION OF DRILL CME 550X ATV			
4. HOLE NO. (As shown on drawing title and file number) 10B01				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 13 UNDISTURBED 0	
5. NAME OF DRILLER Tim Donahue				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 50.0				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+8.0 ±	
9. TOTAL DEPTH OF HOLE 50.0				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST Alan Sweeney, EIT			
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	28' to 30'	3-3-4-8 N=7	Trace shell fragments observed in sample. Laboratory Sample No. 16929	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	33' to 35'	4-3-5-6 N=8	Trace shell fragments observed in sample. Laboratory Sample No. 16930	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	38' to 40'	4-5-5-5 N=10	Trace shell fragments observed in sample.	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	43' to 45'	3-4-5-6 N=9	Trace shell fragments observed in sample.	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	48' to 50'	3-3-4-6 N=7	Trace shell fragments observed in sample.	
-42	50.0		Boring terminated at 50 feet. 1.25 inch diameter hand-slotted piezometer installed to a depth of 18 feet beneath the existing ground surface. Pea gravel was backfilled around the piezometer.			STRATUM 2 - YORKTOWN	

<b>DRILLING LOG</b>		DIVISION NAO	INSTALLATION Langley AFB	SHEET 1 OF 2 SHEETS
1. PROJECT F-22 Hangar Expansion, Langley AFB			10. SIZE AND TYPE OF BIT 2 7/8" Roller Bit	
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,041.6 E 12,108,526.9			11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88	
3. DRILLING AGENCY Fishburne Drilling, Inc.			12. MANUFACTURER'S DESIGNATION OF DRILL CME 550X ATV	
4. HOLE NO. (As shown on drawing title and file number) 10B02			13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN DISTURBED 13 UNDISTURBED 0	
5. NAME OF DRILLER Tim Donahue			14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.			15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN 50.0			16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered			17. ELEVATION TOP OF HOLE +6.0 ±	
9. TOTAL DEPTH OF HOLE 50.0			18. TOTAL CORE RECOVERY FOR BORING %	
			19. GEOLOGIST Alan Sweeney, EIT	

ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g
5.87	0.1		Topsoil	0' to 2'	5-7-6-7 N=13	Topsoil thickness = 1.5 inches Laboratory Sample No. 16931
			[SC] Medium dense, tan and brown, fine to coarse SAND, with some clay and little gravel, moist.	2' to 4'	5-5-6-6 N=11	A bulk sample was collected from a depth of approximately 0 to 4 feet beneath the existing ground surface.
2	4.0		[SC] Medium dense, tan and brown, fine to coarse SAND, with some clay and little gravel, moist.			FILL
			[CL] Firm, orange-brown mottled with gray, Sandy lean CLAY, moist.	4' to 6'	6-3-3-3 N=6	
0	6.0		[SC] Loose, orange-brown, fine to medium SAND, with little clay, wet.	6' to 8'	2-2-2-2 N=4	Laboratory Sample No. 16932
-2	8.0		[SM] Loose, orange-brown mottled with gray, fine to medium SAND, with little silt, wet.	8' to 10'	2-2-2-2 N=4	
						STRATUM 1
-7	13.0		[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	13' to 15'	5-4-6-8 N=10	Switched to mud rotary drilling techniques. Trace shell fragments observed in sample.
			[SM] Medium dense, green-gray, fine to medium SAND, with little silt, wet.	18' to 20'	8-6-8-7 N=14	Trace shell fragments observed in sample. Laboratory Sample No. 16933
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	23' to 25'	6-4-4-4 N=8	Trace shell fragments observed in sample.
						STRATUM 2 - YORKTOWN

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 2 OF 2 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 2 7/8" Roller Bit			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,041.6 E 12,108,526.9				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY Fishburne Drilling, Inc.				12. MANUFACTURER'S DESIGNATION OF DRILL CME 550X ATV			
4. HOLE NO. (As shown on drawing title and file number) 10B02				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 13 UNDISTURBED 0	
5. NAME OF DRILLER Tim Donahue				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 50.0				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+6.0 ±	
9. TOTAL DEPTH OF HOLE 50.0				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST Alan Sweeney, EIT			
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	28' to 30'	3-3-5-5 N=8	Trace shell fragments observed in sample.	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	33' to 35'	2-3-4-6 N=7	Some shell fragments observed in sample.	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	38' to 40'	2-3-3-4 N=6	Trace shell fragments observed in sample. Laboratory Sample No. 16934	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	43' to 45'	2-2-4-5 N=6	Trace shell fragments observed in sample. Laboratory Sample No. 16935	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	48' to 50'	2-3-4-6 N=7	Trace shell fragments observed in sample.	
-44	50.0		Boring terminated at 50 feet. Boring backfilled with pea gravel and a borehole plug upon completion.			STRATUM 2 - YORKTOWN	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 2 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 2 7/8" Roller Bit			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,070.0 E 12,108,477.2				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY Fishburne Drilling, Inc.				12. MANUFACTURER'S DESIGNATION OF DRILL CME 550X ATV			
4. HOLE NO. (As shown on drawing title and file number) 10B03				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 13 UNDISTURBED 0	
5. NAME OF DRILLER Tim Donahue				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 50.0				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+6.3 ±	
9. TOTAL DEPTH OF HOLE 50.0				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST		Alan Sweeney, EIT	
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
6.17	0.1		Topsoil	0' to 2'	3-3-5-8 N=8	Topsoil thickness = 1.5 inches	
			[SC] Loose, tan and brown, fine to coarse SAND, with some clay and little gravel, moist.	2' to 4'	5-5-4-4 N=9	Laboratory Sample No. 16936	
			[SC] Loose, tan and brown, Clayey fine to coarse SAND, with trace gravel, moist.	4' to 6'	4-4-3-3 N=7	FILL	
0.3	6.0		[SM] Loose, orange-brown mottled with tan, fine to medium SAND, with little silt moist.	6' to 8'	3-2-2-2 N=4		
			[SM] Very loose, orange-brown mottled with tan, fine to medium SAND, with little silt, wet.	8' to 10'	3-2-1-2 N=3		
						STRATUM 1	
-6.7	13.0		[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	13' to 15'	4-3-3-5 N=6	Switched to mud rotary drilling techniques. Trace shell fragments observed in sample. Laboratory Sample No. 16937	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	18' to 20'	8-4-5-6 N=9	Trace shell fragments observed in sample. Laboratory Sample No. 16938	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	23' to 25'	5-3-5-6 N=8	Trace shell fragments observed in sample. Laboratory Sample No. 16939	
						STRATUM 2 - YORKTOWN	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 2 OF 2 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 2 7/8" Roller Bit			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,070.0 E 12,108,477.2				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY Fishburne Drilling, Inc.				12. MANUFACTURER'S DESIGNATION OF DRILL CME 550X ATV			
4. HOLE NO. (As shown on drawing title and file number) 10B03				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 13 UNDISTURBED 0	
5. NAME OF DRILLER Tim Donahue				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 50.0				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+6.3 ±	
9. TOTAL DEPTH OF HOLE 50.0				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST		Alan Sweeney, EIT	
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	28' to 30'	5-3-4-6 N=7	Little shell fragments observed in sample. Laboratory Sample No. 16940	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	33' to 35'	3-3-4-4 N=6	Little shell fragments observed in sample. Laboratory Sample No. 16941	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	38' to 40'	3-2-4-5 N=6	Trace shell fragments observed in sample. Laboratory Sample No. 16942	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	43' to 45'	2-3-4-5 N=7	Trace shell fragments observed in sample. Laboratory Sample No. 16943	
			[SM] Loose, green-gray, fine to medium SAND, with little silt, wet.	48' to 50'	3-3-4-7 N=7	Some shell fragments observed in sample. Laboratory Sample No. 16944	
-43.7	50.0		Boring terminated at 50 feet. Boring backfilled with pea gravel and a borehole plug upon completion.			STRATUM 2 - YORKTOWN	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,101.1 E 12,108,406.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP01				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 8.0				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+8.0 ±	
9. TOTAL DEPTH OF HOLE 8.0				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST		Matthew Thornton	
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Orange-brown, fine to coarse SAND, with some clay and trace gravel, moist			PID Reading = 0 from a depth of 0 to 8 feet.	
			[SC] Orange-brown and black, fine to coarse SAND, with some clay and trace gravel, moist.			Environmental Sample collected from a depth of 1 to 4 feet	
			[CL] Orange-brown mottled with gray, Sandy lean CLAY, moist.			Clayey GRAVEL lense from an approximate depth of 2.3 to 2.6 feet beneath the existing ground surface.	
2	6.0					FILL	
0	8.0					STRATUM 1	
			Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.				

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,041.6 E 12,108,526.9				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP02				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 7.2				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+6.0 ±	
9. TOTAL DEPTH OF HOLE 7.2				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST		Matthew Thornton	
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Orange-brown and black, fine to coarse SAND, with some clay and trace gravel, moist.			PID Reading = 0 from a depth of 0 to 7.2 feet.	
2.5	3.5		[CL] Orange-brown mottled with gray, lean CLAY SAND, with some sand and trace gravel, moist.			Environmental Sample collected from a depth of 1.3 to 3.5 feet	
0	6.0		[SC] Orange-brown mottled with gray, fine to medium SAND, with some clay, wet.			FILL	
-1.2	7.2		No Recovery			STRATUM 1	
-2	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.				



DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,070.0 E 12,108,477.2				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP03				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 6.1				17. ELEVATION TOP OF HOLE +6.3 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 6.1							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown, Clayey fine to coarse SAND, moist.			PID Reading = 0 from a depth of 0 to 6.1 feet.	
			[SC] Brown and gray-brown mottled with orange-brown, Clayey fine to coarse SAND, with trace gravel, moist.			Environmental Sample collected from a depth of 2.1 to 3.4 feet	
1.3	5.0		[SC] Orange-brown mottled with gray, Clayey fine to coarse SAND, moist.			Fill	
0.2	6.1		No Recovery				
-1.7	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,086.0 E 12,108,577.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP04				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 8.0				17. ELEVATION TOP OF HOLE +6.5 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 8.0							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
6.2	0.3	[SC] Brown, fine to medium SAND, with some clay, moist.				PID Reading = 0 from a depth of 0 to 8 feet.	
5.8	0.7	[SP-SC] Gray, fine to coarse SAND, with little clay and little gravel, moist.				Environmental Sample collected from a depth of 2 to 4 feet	
		[SC] Light brown and orange-brown, Clayey fine to coarse SAND, with trace gravel, moist.				FILL	
1.4	5.1	[SC] Orange-brown and gray, fine to medium SAND and clay, wet.				STRATUM 1	
-1.5	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.				

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,028.3 E 12,108,628.0				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP05				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 5.6				17. ELEVATION TOP OF HOLE +6.6 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 5.6							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
4.6	2.0		[SC] Brown and gray brown, Clayey fine to coarse SAND, moist.			PID Reading = 0 from a depth of 0 to 5.6 feet.	
			[SC] Brown and gray brown, Clayey fine to coarse SAND, moist.			FILL	
			[SC] Orange-brown mottled with gray, Clayey fine to coarse SAND, moist.			Environmental Sample collected from a depth of 2 to 3.3 feet	
1	5.6		No Recovery				
-1.4	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,112.0 E 12,108,661.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP06				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 5.1				17. ELEVATION TOP OF HOLE +6.5 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 5.1							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.			PID Reading = 0 from a depth of 0 to 5.1 feet.	
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.				
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.			Environmental Sample collected from a depth of 2 to 4 feet	
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.				
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.				
1.4	5.1		No Recovery			FILL	
-1.5	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,117.1 E 12,108,500.6				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP07				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 8.0				17. ELEVATION TOP OF HOLE +6.1 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 8.0							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown to light brown, Clayey fine to coarse SAND, with trace gravel, moist.			PID Reading = 0 from a depth of 0 to 8 feet.	
						Environmental Sample collected from a depth of 2.5 to 4 feet	
1.1	5.0		[SC] Orange-brown mottled with gray, Clayey fine to medium SAND, wet.			FILL	
-1.9	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,061.7 E 12,108,415.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP08				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 8.0				17. ELEVATION TOP OF HOLE +6.9		±	
8. DEPTH DRILLED INTO ROCK Not Encountered				18. TOTAL CORE RECOVERY FOR BORING		%	
9. TOTAL DEPTH OF HOLE 8.0				19. GEOLOGIST Matthew Thornton			
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown and gray, fine to coarse SAND, with some clay, moist.			PID Reading = 0 from a depth of 0 to 8 feet.	
						Environmental Sample collected from a depth of 2 to 4 feet	
						FILL	
1.4	5.5		[SC] Orange-brown mottled with gray, fine to medium SAND, with some clay, wet.			STRATUM 1	
-1.1	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.				

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,054.8 E 12,108,349.8				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP09				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 6.0				17. ELEVATION TOP OF HOLE +7.2		±	
8. DEPTH DRILLED INTO ROCK Not Encountered				18. TOTAL CORE RECOVERY FOR BORING		%	
9. TOTAL DEPTH OF HOLE 6.0				19. GEOLOGIST Matthew Thornton			
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown, Clayey fien to coarse SAND, with trace gravel, moist.			PID Reading = 0 from a depth of 0 to 6 feet.	
3.2	4.0		[SC] Orange-brown mottled with gray, fine to coarse SAND, with some clay and trace gravel, moist.			Environmental Sample collected from a depth of 2 to 4 feet	
1.2	6.0		Geoprobe terminated at a depth of 6 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1 Refusal at a depth of 6 due to an obstruction	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,558,986.4 E 12,108,514.7				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP10				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 5.6				17. ELEVATION TOP OF HOLE +6.3 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 5.6							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
4.3	2.0	[SM] Gray, fine to medium SAND, with some clay, moist.				PID Reading = 0 from a depth of 0 to 5.6 feet.	
						FILL	
			[SC] Orange-brown mottled with gray, Clayey fine to coarse SAND, with trace gravel, moist.			Environmental Sample collected from a depth of 2 to 4 feet	
0.7	5.6		No Recovery			STRATUM 1	
-1.7	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.				





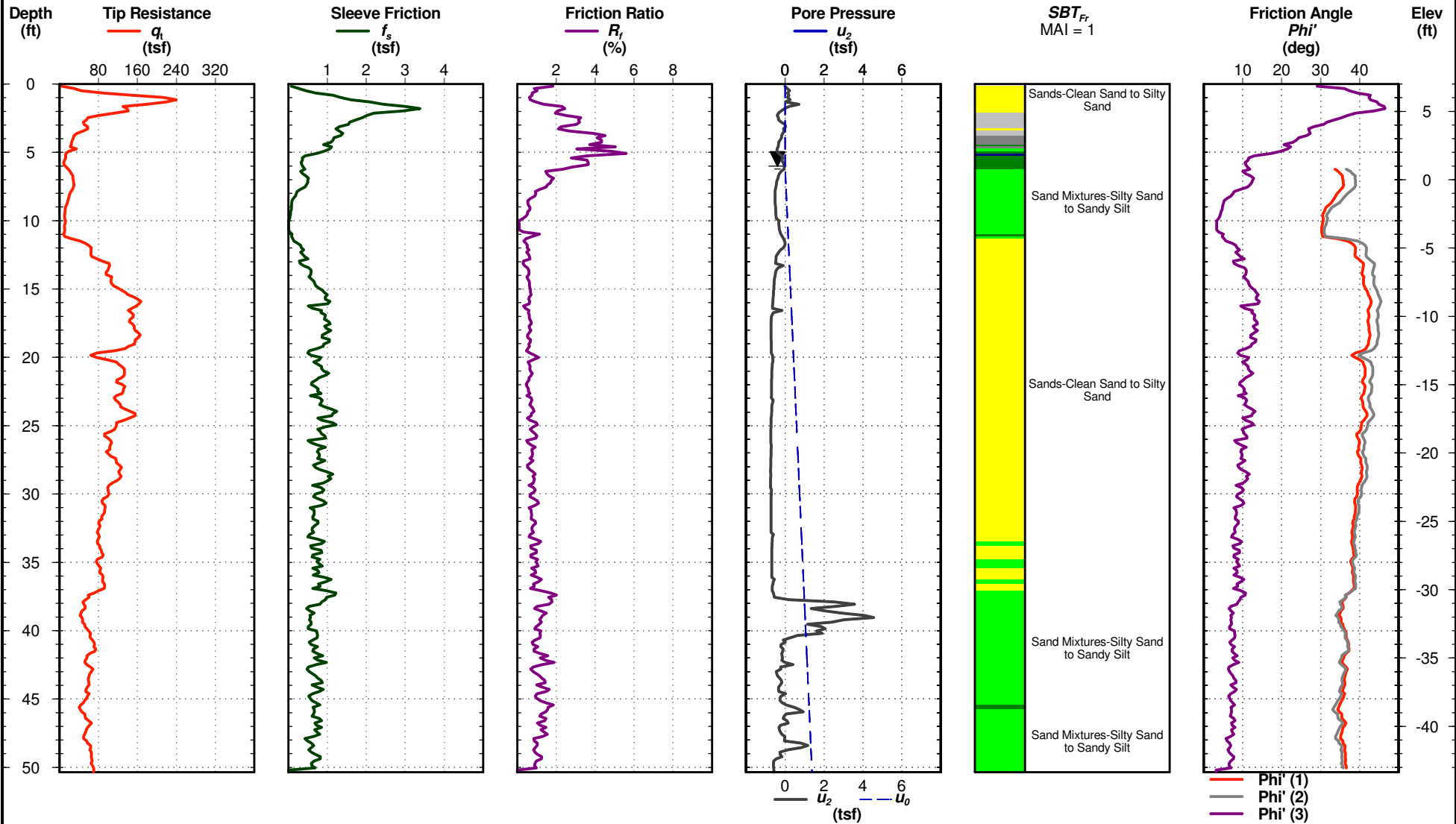
F-22 Hangar Expansion  
Langley AFB, Hampton, Virginia (Hampton, Virginia)  
S&ME Project No: 1081-10-2718

Cone Penetration Test

10CPT01

Date: January 20, 2010  
Estimated Water Depth: 6 ft  
Rig/Operator: CPT Truck / Richard Haller

Total Depth: 50.4 ft  
Termination Criteria: Target Depth  
Cone Size: 15 cm<sup>2</sup>



10CPT01



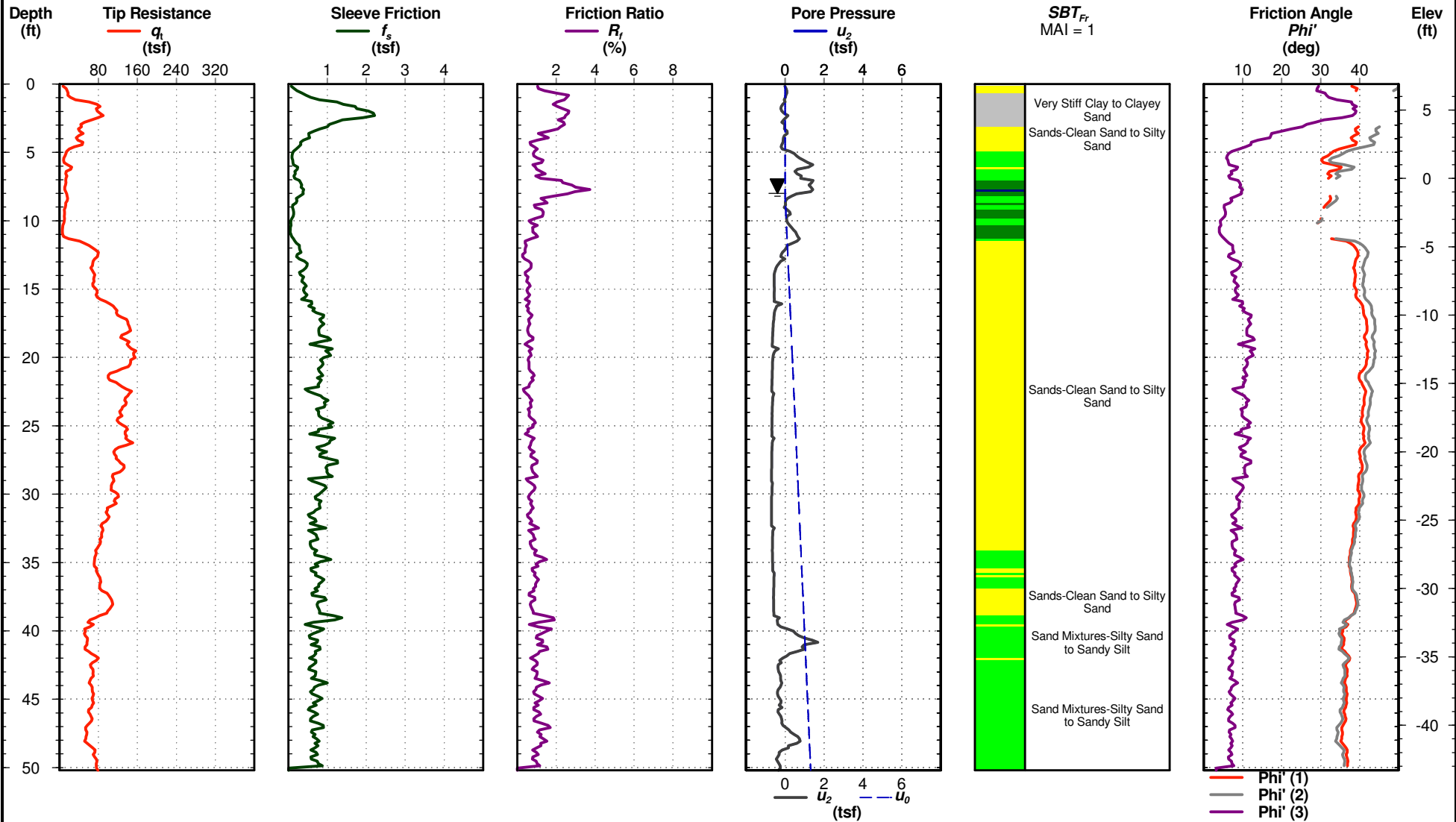
F-22 Hangar Expansion  
Langley AFB, Hampton, Virginia (Hampton, Virginia)  
S&ME Project No: 1081-10-2718

Cone Penetration Test

10CPT02

Date: January 20, 2010  
Estimated Water Depth: 8 ft  
Rig/Operator: CPT Truck / Richard Haller

Total Depth: 50.2 ft  
Termination Criteria: Target Depth  
Cone Size: 15 cm<sup>2</sup>



10CPT02

# COARSE-GRAINED SOIL

Less than Half the Material is Smaller Than the No. 200 Sieve

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART		
COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
<b>GRAVELS</b> More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
<b>SANDS</b> 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures

LABORATORY CLASSIFICATION CRITERIA		
GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP  
 More than 12 percent ..... GM, GC, SM, SC  
 5 to 12 percent ..... Borderline cases requiring dual symbols

## Grain Size

Material	Fraction	Sieve Size
Boulders	--	12"+
Cobbles	--	3" - 12"
Gravel	coarse	3/4" - 3"
	fine	No. 4 to 3/4"
Sand	coarse	No. 10 to No. 4
	medium	No. 40 to No. 10
	fine	No. 100 to No. 40
	very fine	No. 200 to No. 100

## Course Grained Soil Density

SPT Penetration	Term
< 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
> 50	Very Dense

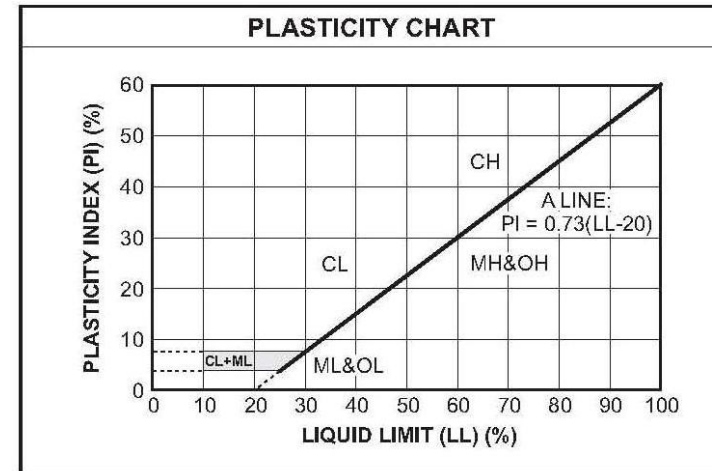
Coarse & Fine Grained Soil Classification	
Descriptive Term	Percentage
Trace	1 - 10%
little	10 - 20%
some	20 - 35%
adjective	35 - 50%

Soil Description: Density, Color, Soil Classification with major component capitalized, moisture content, USCS

## FINE-GRAINED SOIL

More than Half the Material is Smaller Than the No. 200 Sieve

FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
<b>SILTS AND CLAYS</b> Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
<b>SILTS AND CLAYS</b> Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
<b>HIGHLY ORGANIC SOILS</b>	PT	Peat and other highly organic soils



### Coarse & Fine Grained Soil Classification

Descriptive Term	Thickness
parting	0 to 1/16" thickness
seam	1/16 to 1/2" thickness
layer	1/2 to 12" thickness
pocket	small, erratic deposit
lens	lenticular deposit
occasional	one or less per foot
frequent	more than one per foot

### Coarse & Fine Grained Soil Classification

Descriptive Term	Percentage
trace	1 - 10%
little	10 - 20%
some	20 - 35%
adjective	35 - 50%

### Fine Grained Soil Consistency

SPT Penetration	Term	Behavior	Unconfined Strength, tsf
< 2	Very Soft	extruded from between fingers when squeezed	< 0.25
2 - 4	Soft	molded by light finger pressure	0.25 - 0.5
4 - 8	Firm	molded by strong finger pressure	.5 - 1
8 - 15	Stiff	indented by thumb	1 - 2
15 - 30	Very Stiff	indented by thumb nail	2 - 4
> 30	Hard	difficult to indent by thumb nail	> 4

Soil Description: Consistency, Color, Soil Classification with major component capitalized, moisture content, USCS



### KEY TO USCS TERMINOLOGY AND GRAPHIC SYMBOLS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	USCS	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LESS THAN 5% PASSING THE #200 SIEVE)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES. LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES. LITTLE OR NO FINES
		GRAVELS WITH FINES (MORE THAN 12% PASSING THE #200 SIEVE)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	SAND AND SANDY SOILS			GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
		CLEAN SANDS (LESS THAN 5% PASSING THE #200 SIEVE)		SW	WELL-GRADED SANDS, GRAVELLY SANDS. LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND. LITTLE OR NO FINES
FINE GRAINED SOILS	SILTS AND CLAYS	<15% Retained on #200 Sieve SILT OR CLAY		ML	INORGANIC SILTS WITH LOW PLASTICITY, SANDY OR GRAVELLY SILT, ROCK FLOUR, CLAYEY SILT
		15% to 30% Retained on #200 Sieve SILT OR CLAY WITH SAND OR GRAVEL		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, LEAN CLAY, SANDY OR GRAVELLY LEAN CLAY, SILTY CLAYS
		>30% Retained on #200 Sieve SANDY OR GRAVELLY SILT OR CLAY		OL	ORGANIC SILTS AND ORGANIC CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	<15% Retained on #200 Sieve SILT OR CLAY		MH	INORGANIC SILTS OF HIGH PLASTICITY, ELASTIC SILT, SANDY OR GRAVELLY ELASTIC SILT, CLAYEY SILT
		15% to 30% Retained on #200 Sieve SILT OR CLAY WITH SAND OR GRAVEL		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAY, SANDY OR GRAVELLY FAT CLAY, SILTY CLAY
		>30% Retained on #200 Sieve SANDY OR GRAVELLY SILT OR CLAY		OH	ORGANIC SILTS AND CLAYS OF MEDIUM TO HIGH PLASTICITY
	HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

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## **DIRECT ROTARY DRILLING WITH DRILLING FLUID AND SAMPLING METHOD**

A borehole is advanced using rotation of a drill bit or casing and/or the application of mechanical or fluid pressure. The bit loosens the material at the bottom of the hole. The loosened material is removed by a circulating drilling fluid (such as water, air, or a bentonite water solution) injected through the drill rods and bit. Casing or drilling fluid is used to maintain borehole stability.

At a specified interval the drill bit is removed from the drill rods and a standard split barrel sampling spoon is attached and lowered to bear on the soil below. The driller uses an automatic trip hammer which raises a 140-pound (65 kg) weight and allows it to freely drop 30-inches (76 cm) to drive the sampling spoon. The number of blows (blow count) required to drive the sampling spoon is recorded for three successive 6-inch increments. This is the Standard Penetration Test (SPT).

The SPT N-value is the sum of the blow counts for the last two 6-inch increments. If the blow count for any 6-inch increment exceeds 50, or if the total blow count exceeds 100 at any time, or if 10 blows have not penetrated the soil strata any further, the test may be terminated as “sampler refusal.” The N-value is used as an indication of the consistency of fine grained soils (e.g., soft, stiff, hard) or as an indication of relative density of coarse grained soils (e.g., loose, dense, very dense).

### **SOIL CONTACTS**

Contacts between soil types are shown on the boring logs. Sometimes these contacts are observed in soil samples and therefore their location is reasonably well known. At other times the contacts may be gradational or may occur between soil samples. The location of these soil contacts is then approximated or inferred. Therefore, it is appropriate to assume that the contacts shown on the boring logs are approximate. Contacts shown with solid lines on the boring logs are major contacts between soil strata while the contacts shown with dashed lines indicate variation within a single stratum.

### **SAMPLE DISPOSITION**

All soil samples collected during the field exploration program and not used in laboratory testing will be stored for sixty (60) days after report date and then discarded unless other arrangements are completed.

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### **APPENDIX III – LABORATORY TEST RESULTS**

Laboratory Summary Table (2 pages)

Grain Size Distribution (3 pages)

Atterberg Limits Results (1 page)

Modified Proctor Moisture-Density Relationship Test Results (2 pages)

California Bearing Ratio (CBR) Test Results (2 pages)

<b>Sample Location</b>	<b>10B01</b>	<b>10B01</b>	<b>10B01</b>	<b>10B01</b>	<b>10B01</b>	<b>10B02</b>	<b>10B02</b>	<b>10B02</b>	<b>10B02</b>	<b>10B02</b>
<b>S&amp;ME Sample Number</b>	<b>16926</b>	<b>16927</b>	<b>16928</b>	<b>16929</b>	<b>16930</b>	<b>16931</b>	<b>16932</b>	<b>16933</b>	<b>16934</b>	<b>16935</b>
<b>Sample Interval (feet)</b>	<b>0.5 - 5.0</b>	<b>8.0 - 10.0</b>	<b>13.0 - 15.0</b>	<b>28.0 - 30.0</b>	<b>33.0 - 35.0</b>	<b>0.5 - 4.0</b>	<b>6.0 - 8.0</b>	<b>18.0 - 20.0</b>	<b>38.0 - 40.0</b>	<b>43.0 - 45.0</b>
<b>Sample Type</b>	<b>Bulk</b>	<b>Split Spoon</b>	<b>Split Spoon</b>	<b>Split Spoon</b>	<b>Split Spoon</b>	<b>Bulk</b>	<b>Split Spoon</b>	<b>Split Spoon</b>	<b>Split Spoon</b>	<b>Split Spoon</b>
<b>Natural Moisture Content (%)</b>	13.5	33.5	32.8	30.1	32.5	16.6	33.7	28.4	32.6	34.6
<b><u>Atterberg Limits</u></b>										
Liquid Limit	22	32	25	26	27	29	31	25	28	31
Plastic Limit	14	24	23	23	24	19	19	23	24	24
Plasticity Index	8	8	2	3	3	10	12	2	4	7
<b><u>Gradation Analysis</u></b>										
% Finer by Weight										
Sieve: 3 inch										
2.5 inch										
2 inch										
1.5 inch										
1 inch										
3/4 inch										
1/2 inch	100.0					100.0				
3/8 inch	97.9					92.9			100.0	
No. 4	94.2		100.0	100.0	100.0	87.7	100.0	100.0	99.8	100.0
No. 10	91.5	100.0	99.8	99.7	99.9	83.9	99.9	99.7	99.7	99.8
No. 40	83.4	99.8	99.1	98.8	99.4	73.5	99.8	97.8	99.4	99.6
No. 100	45.5	47.5	38.4	39.3	55.7	42.8	44.4	43.3	66.5	69.2
No. 200	30.0	18.5	12.4	13.9	16.1	28.3	16.3	12.2	18.5	19.7
<b><u>Compaction Test (ASTM D1557)</u></b>										
Maximum Dry Density (pcf)	127.6					123.0				
Optimum Moisture Content (%)	9.7					10.5				
Corrected Max Dry Density (pcf)	129.5					127.2				
Corrected Opt. Moisture Content (%)	9.2					9.3				
<b><u>California Bearing Ratio (ASTM D1883)</u></b>										
Soaked CBR	34.3					83.1				
Molded Dry Density (pcf)	130.4					124.0				
Molded Moisture Content (%)	8.6					8.0				
% Swell	1.0					0.2				
<b>USCS Soil Classification</b>	<b>SC</b>	<b>SM</b>	<b>SM</b>	<b>SM</b>	<b>SM</b>	<b>SC</b>	<b>SC</b>	<b>SM</b>	<b>SM</b>	<b>SM</b>
<b>AASHTO Soil Classification</b>	<b>A-2-4 (0)</b>	<b>A-2-4 (0)</b>	<b>A-2-4 (0)</b>	<b>A-2-4 (0)</b>	<b>A-2-4 (0)</b>	<b>A-2-4 (0)</b>	<b>A-2-6 (0)</b>	<b>A-2-4 (0)</b>	<b>A-2-4 (0)</b>	<b>A-2-4 (0)</b>



8211 Hermitage Road  
Richmond, VA 23228  
Telephone: (804) 266-2199  
Fax: (804) 261-5569

## LABORATORY SUMMARY TABLE

Project: F-22 Hangar Expansion, Langley AFB

Location: Hampton, VA

Number: 1081-10-2718



<b>Sample Location</b>	10B03	10B03	10B03	10B03	10B03	10B03	10B03	10B03	10B03
<b>S&amp;ME Sample Number</b>	16936	16937	16938	16939	16940	16941	16942	16943	16944
<b>Sample Interval (feet)</b>	2.0 - 4.0	13.0 - 15.0	18.0 - 20.0	23.0 - 25.0	28.0 - 30.0	33.0 - 35.0	38.0 - 40.0	43.0 - 45.0	48.0 - 50.0
<b>Sample Type</b>	Split Spoon	Split Spoon	Split Spoon	Split Spoon	Split Spoon	Split Spoon	Split Spoon	Split Spoon	Split Spoon
<b>Natural Moisture Content (%)</b>	19.7	32.8	30.0	32.3	33.8	31.9	33.2	33.2	31.6

**Atterberg Limits**

Liquid Limit	40			28
Plastic Limit	17			24
Plasticity Index	23			4

**Gradation Analysis**

% Finer by Weight

Sieve:	3 inch								
	2.5 inch								
	2 inch								
	1.5 inch								
	1 inch								
	3/4 inch								
	1/2 inch	100.0							
	3/8 inch	97.6							
	No. 4	95.8			100.0				
	No. 10	90.2			99.9				
	No. 40	82.8			99.1				
	No. 100	60.0			44.7				
	No. 200	39.5			15.6		19.4		

**Compaction Test (ASTM D1557)**

Maximum Dry Density (pcf)  
 Optimum Moisture Content (%)  
 Corrected Max Dry Density (pcf)  
 Corrected Opt. Moisture Content (%)

**California Bearing Ratio (ASTM D1883)**

Soaked CBR  
 Molded Dry Density (pcf)  
 Molded Moisture Content (%)  
 % Swell

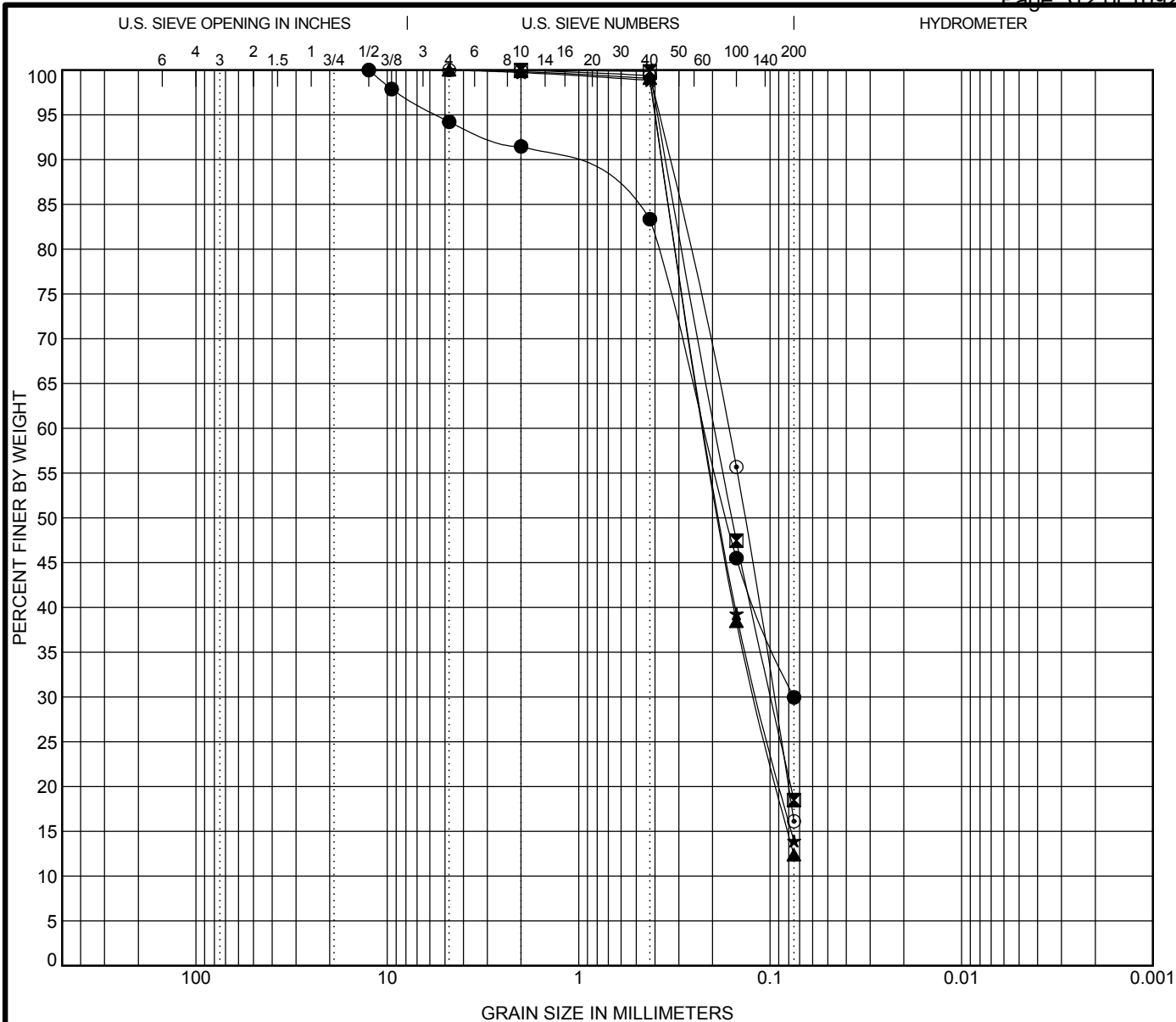
<b>USCS Soil Classification</b>	SC	SM
<b>AASHTO Soil Classification</b>	A-6 (4)	A-2-4 (0)

**LABORATORY SUMMARY TABLE**

Project: F-22 Hangar Expansion, Langley AFB  
 Location: Hampton, VA  
 Number: 1081-10-2718



8211 Hermitage Road  
 Richmond, VA 23228  
 Telephone: (804) 266-2199  
 Fax: (804)261-5569



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification				Classification			LL	PL	PI	Cc	Cu
●	10B01	16926	0.5 ft	CLAYEY SAND SC			22	14	8		
⊗	10B01	16927	8.0 ft	SILTY SAND SM			32	24	8		
▲	10B01	16928	13.0 ft	SILTY SAND SM			25	23	2	0.94	3.09
★	10B01	16929	28.0 ft	SILTY SAND SM			26	23	3		
⊙	10B01	16930	33.0 ft	SILTY SAND SM			27	24	3		
Specimen Identification				D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	10B01	16926	0.5 ft	12.5	0.224	0.075		5.8	64.3	30.0	
⊗	10B01	16927	8.0 ft	2	0.192	0.099		0.0	81.5	18.5	
▲	10B01	16928	13.0 ft	4.75	0.217	0.12		0.0	87.6	12.4	
★	10B01	16929	28.0 ft	4.75	0.215	0.116		0.0	86.1	13.9	
⊙	10B01	16930	33.0 ft	4.75	0.166	0.096		0.0	83.9	16.1	



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Fax: (804) 261-5569

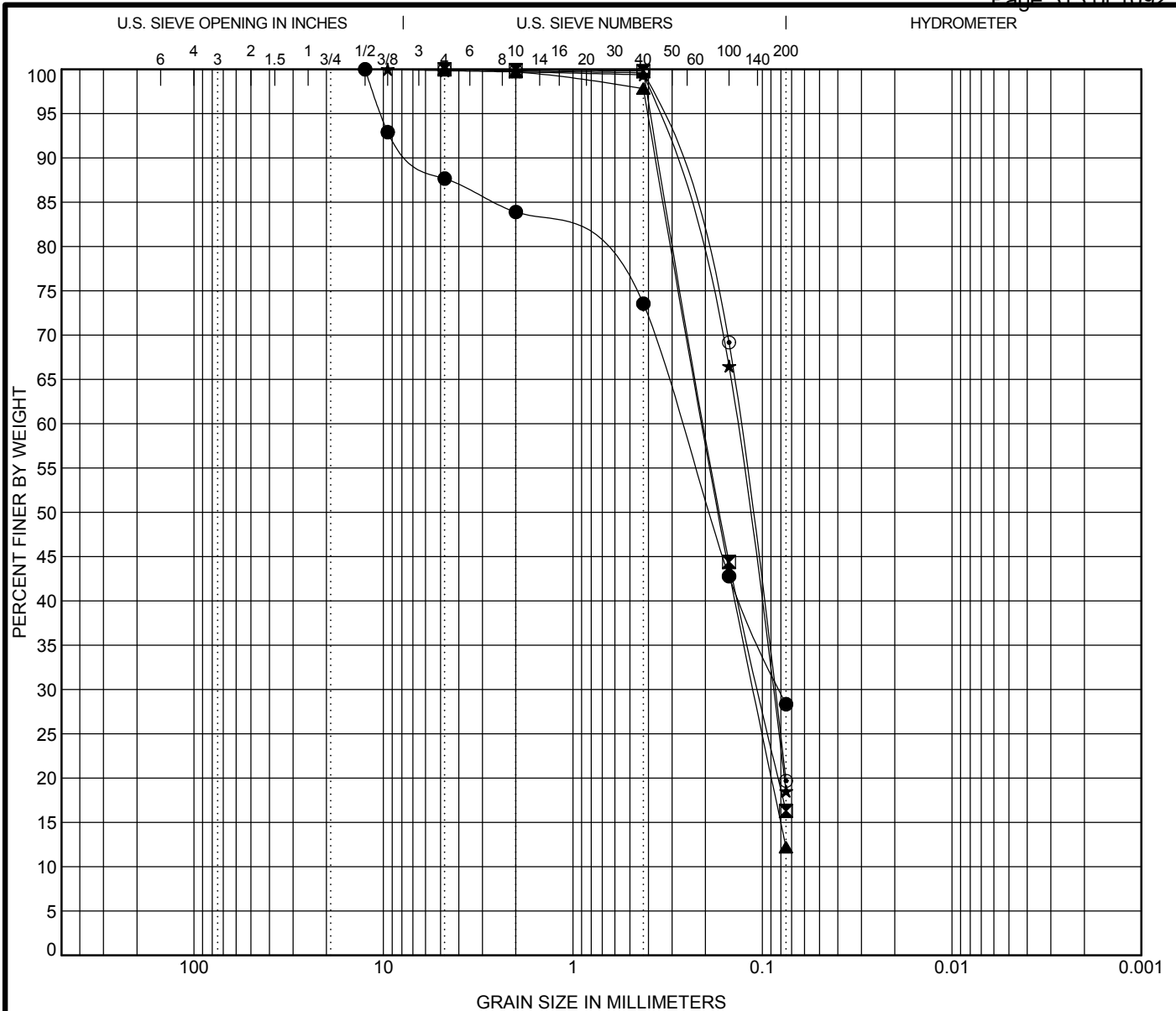
## GRAIN SIZE DISTRIBUTION

Project: F-22 Hangar Expansion, Langley AFB

Location: Hampton, VA

Number: 1081-10-2718

Tuesday, July 13, 2010



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification				Classification			LL	PL	PI	Cc	Cu
●	10B02	16931	0.5 ft	CLAYEY SAND SC			29	19	10		
☒	10B02	16932	6.0 ft	CLAYEY SAND SC			31	19	12		
▲	10B02	16933	18.0 ft	SILTY SAND SM			25	23	2	0.84	2.89
★	10B02	16934	38.0 ft	SILTY SAND SM			28	24	4		
◎	10B02	16935	43.0 ft	SILTY SAND SM			31	24	7		
Specimen Identification				D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	10B02	16931	0.5 ft	12.5	0.269	0.081		12.3	59.3	28.3	
☒	10B02	16932	6.0 ft	4.75	0.201	0.105		0.0	83.7	16.3	
▲	10B02	16933	18.0 ft	4.75	0.206	0.111		0.0	87.8	12.2	
★	10B02	16934	38.0 ft	9.5	0.137	0.089		0.2	81.3	18.5	
◎	10B02	16935	43.0 ft	4.75	0.132	0.087		0.0	80.3	19.7	



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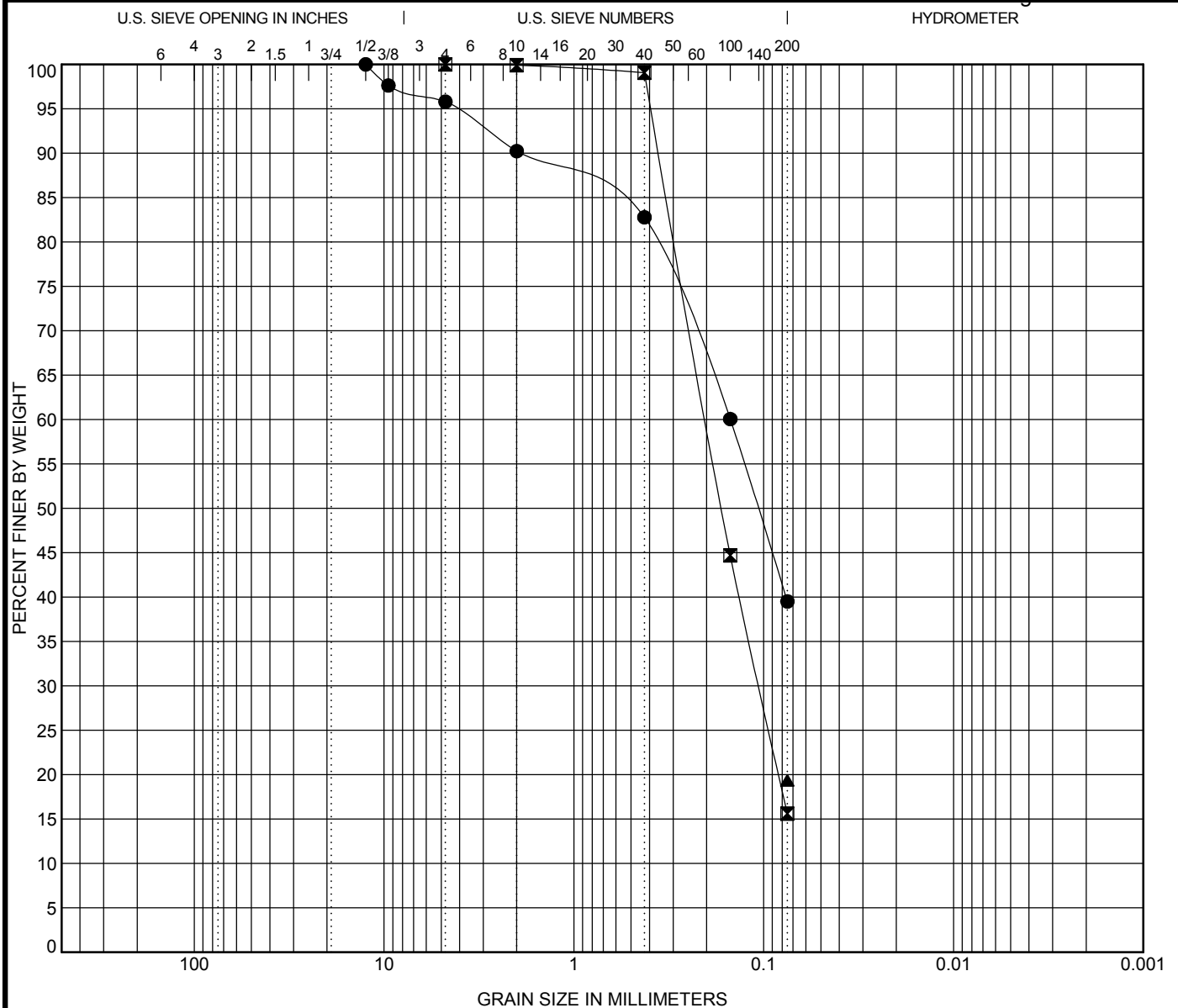
### GRAIN SIZE DISTRIBUTION

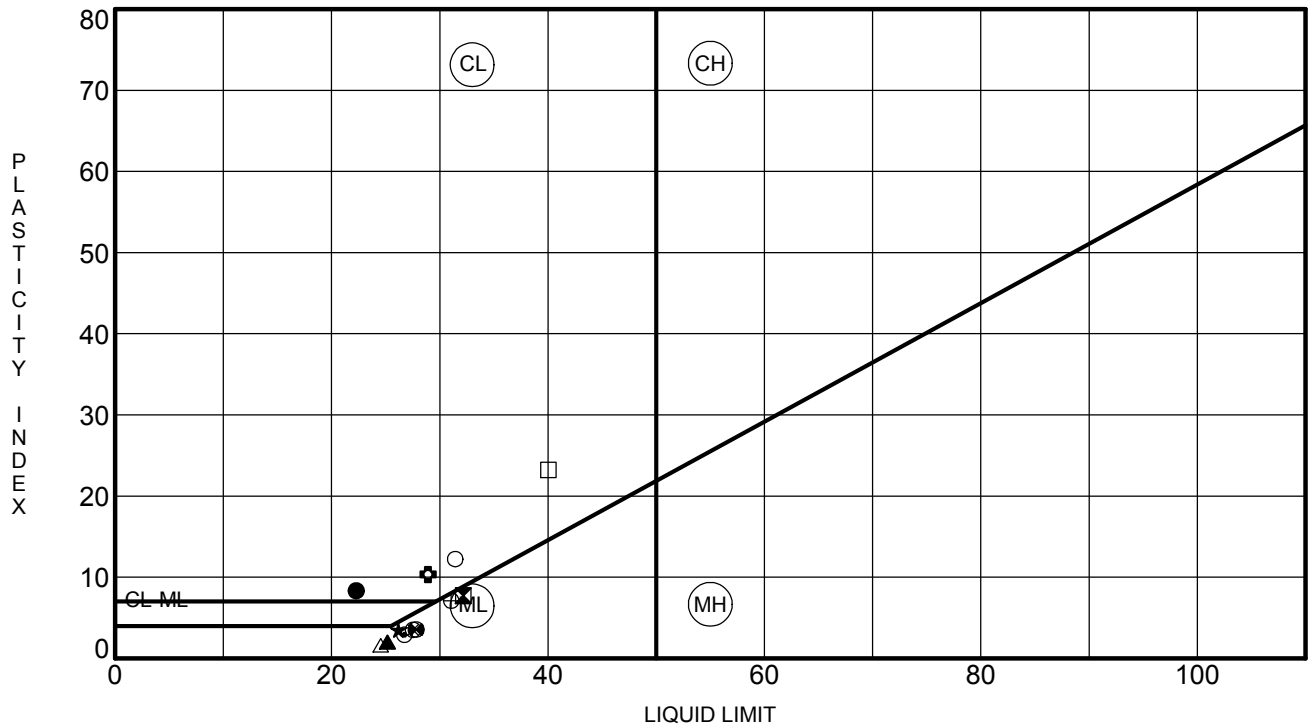
Project: F-22 Hangar Expansion, Langley AFB

Location: Hampton, VA

Number: 1081-10-2718

Tuesday, July 13, 2010





Specimen Identification	LL	PL	PI	Fines	MC	Classification
● 10B01 16926 0.5 ft	22	14	8	30	13.5	CLAYEY SAND SC
⊠ 10B01 16927 8.0 ft	32	24	8	18	33.5	SILTY SAND SM
▲ 10B01 16928 13.0 ft	25	23	2	12	32.8	SILTY SAND SM
★ 10B01 16929 28.0 ft	26	23	3	14	30.1	SILTY SAND SM
⊙ 10B01 16930 33.0 ft	27	24	3	16	32.5	SILTY SAND SM
⊕ 10B02 16931 0.5 ft	29	19	10	28	16.6	CLAYEY SAND SC
○ 10B02 16932 6.0 ft	31	19	12	16	33.7	CLAYEY SAND SC
△ 10B02 16933 18.0 ft	25	23	2	12	28.4	SILTY SAND SM
⊗ 10B02 16934 38.0 ft	28	24	4	19	32.6	SILTY SAND SM
⊕ 10B02 16935 43.0 ft	31	24	7	20	34.6	SILTY SAND SM
□ 10B03 16936 2.0 ft	40	17	23	40	19.7	CLAYEY SAND SC
⊗ 10B03 16939 23.0 ft	28	24	4	16	32.3	SILTY SAND SM



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### ATTERBERG LIMITS RESULTS

Project: F-22 Hangar Expansion, Langley AFB

Location: Hampton, VA

Number: 1081-10-2718

Tuesday, July 13, 2010

Form No. TR-D698-2

Revision No. : 0

Revision Date: 11/21/07

## Moisture - Density Report



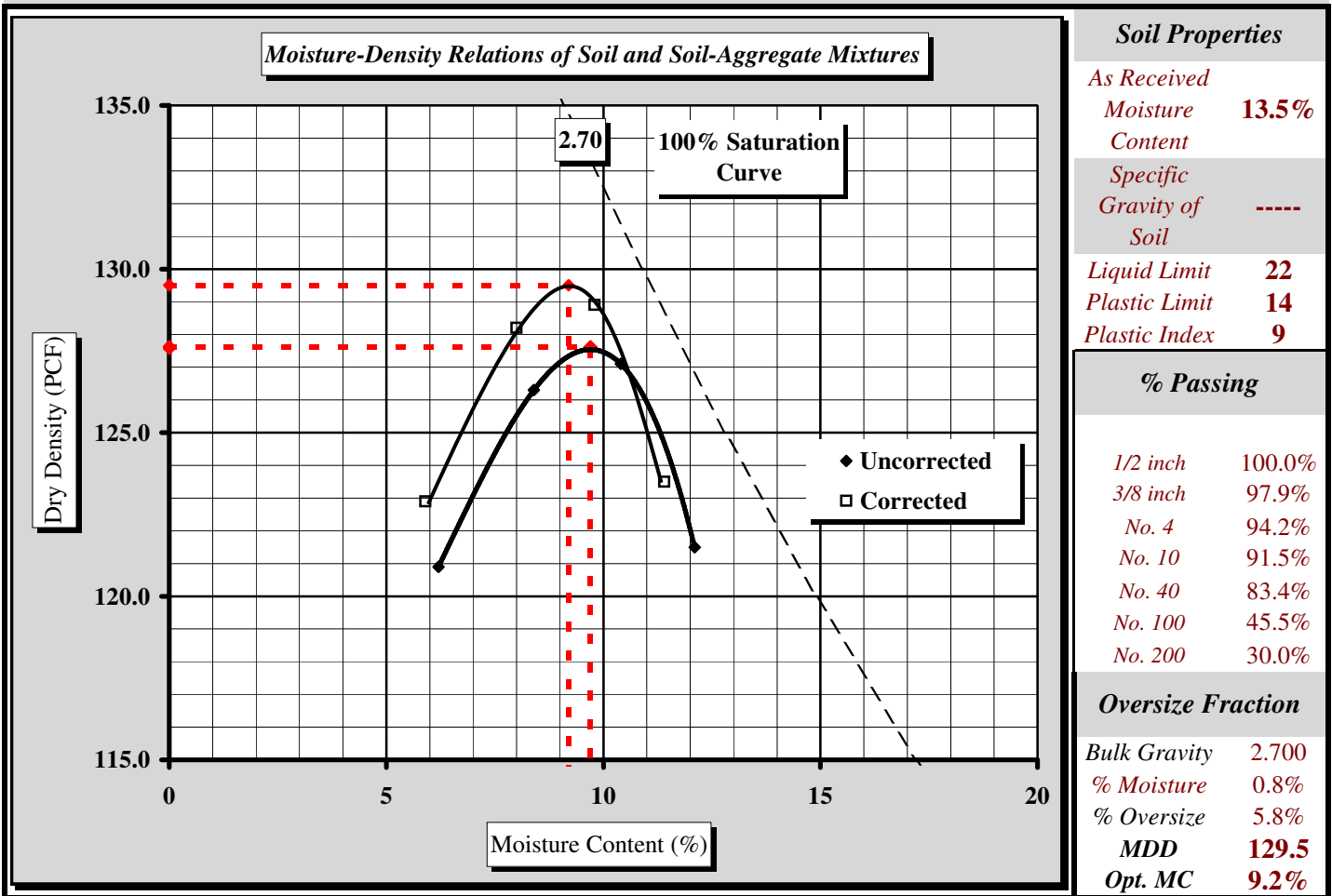
Quality Assurance

S&amp;ME, Inc. - Richmond, 8211 Hermitage Road Richmond, Virginia 23228

S&ME Project #:	<b>1081-10-2718</b>	Report Date:	1/27/2010
Project Name:	F-22 Hangar Expansion, LAFB, Hampton, VA	Test Date(s):	1/26/2010
Client Name:	USACE - Norfolk District		
Client Address:	Norfolk, Virginia		
Location:	10B01	Sample #:	16926
		Sample Date:	1/20/2010
		Offset:	-----
		Depth:	0.5 to 5 feet
USCS Description:	Brown, clayey SAND (SC)	AASHTO:	A-2-4 (0)

Maximum Dry Density **127.6** PCF.Optimum Moisture Content **9.7%**

ASTM D1557 -- Method A



Moisture-Density Curve Displayed: Fine Fraction ☒ Corrected for Oversize Fraction (ASTM D 4718) ☒  
 Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐  
 Mechanical Rammer ☒ Manual Rammer ☐ Moist Preparation ☐ Dry Preparation ☒

**References / Comments / Deviations:**

BULK SPECIFIC GRAVITY AND MOISTURE FOR OVERSIZE FRACTION IS ESTIMATED.

Form No. TR-D698-2

Revision No. : 0

Revision Date: 11/21/07

## Moisture - Density Report



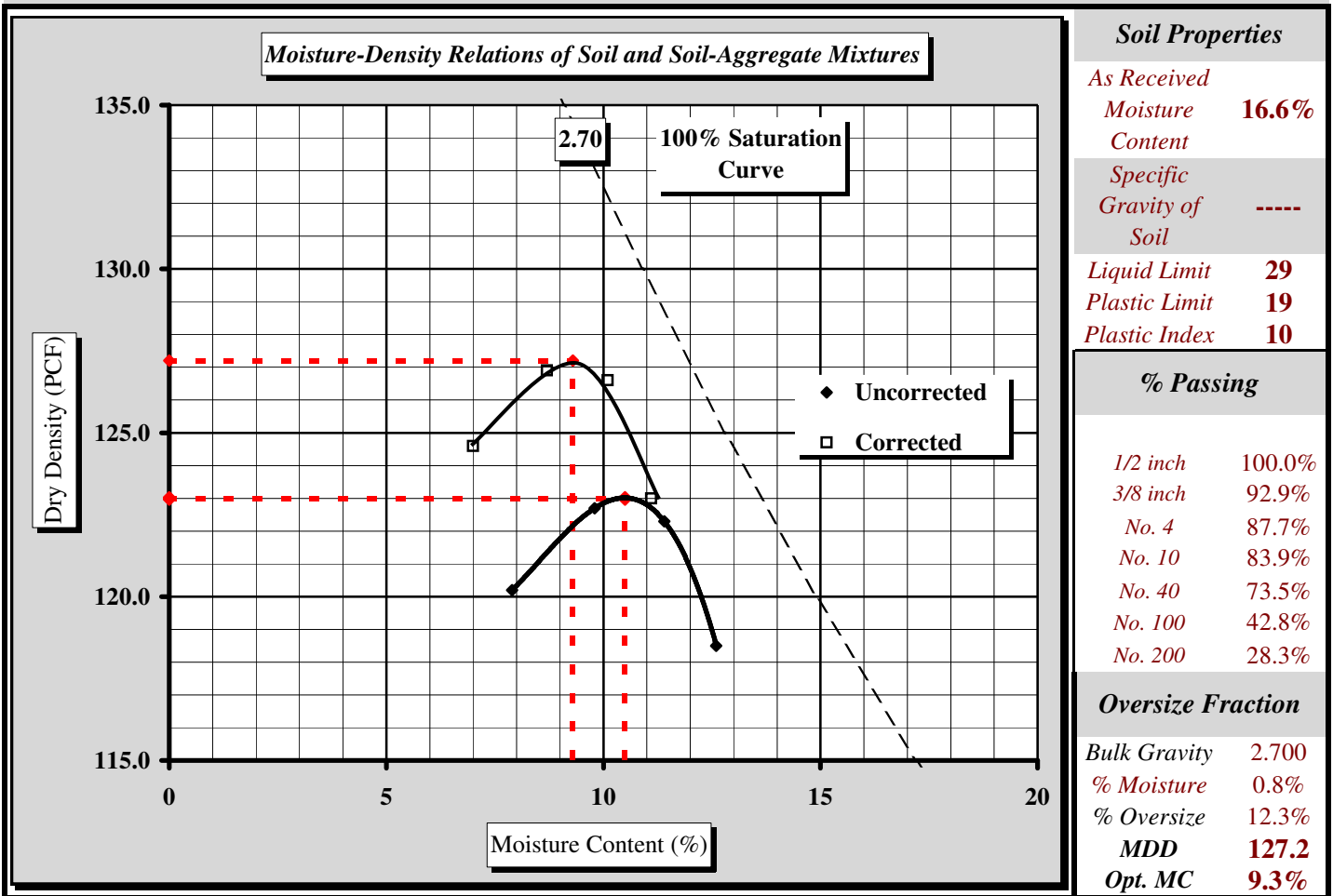
Quality Assurance

S&amp;ME, Inc. - Richmond, 8211 Hermitage Road Richmond, Virginia 23228

S&ME Project #:	<b>1081-10-2718</b>	Report Date:	1/27/2010
Project Name:	F-22 Hangar Expansion, LAFB, Hampton, VA	Test Date(s):	1/26/2010
Client Name:	USACE - Norfolk District		
Client Address:	Norfolk, Virginia		
Location:	10B02	Sample #:	16931
		Sample Date:	1/20/2010
		Offset:	-----
		Depth:	0.5 to 4 feet
USCS Description:	Brown, clayey SAND (SC)	AASHTO:	A-2-4 (0)

Maximum Dry Density **123.0** PCF.Optimum Moisture Content **10.5**%

ASTM D1557 -- Method A



Moisture-Density Curve Displayed: Fine Fraction ☒ Corrected for Oversize Fraction (ASTM D 4718) ☒  
 Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐  
 Mechanical Rammer ☒ Manual Rammer ☐ Moist Preparation ☐ Dry Preparation ☒

**References / Comments / Deviations:**

BULK SPECIFIC GRAVITY AND MOISTURE FOR OVERSIZE FRACTION IS ESTIMATED.

Form No. TR-D1883-T193-3

Revision No. 1

Revision Date: 9/29/08

**CBR (California Bearing Ratio) of Laboratory  
Compacted Soil**

ASTM D 1883



Quality Assurance

S&amp;ME, Inc. Richmond, 8211 Hermitage Road Richmond, Virginia 23228

<b>Project #:</b>	<b>1081-10-2718</b>	<b>Report Date:</b>	<b>2/9/2010</b>
<b>Project Name:</b>	<b>F-22 Hangar Expansion, Langley AFB, Hampton, VA</b>	<b>Test Date(s)</b>	<b>2/2/10 to 2/8/10</b>
<b>Client Name:</b>	<b>USACE - Norfolk District</b>		

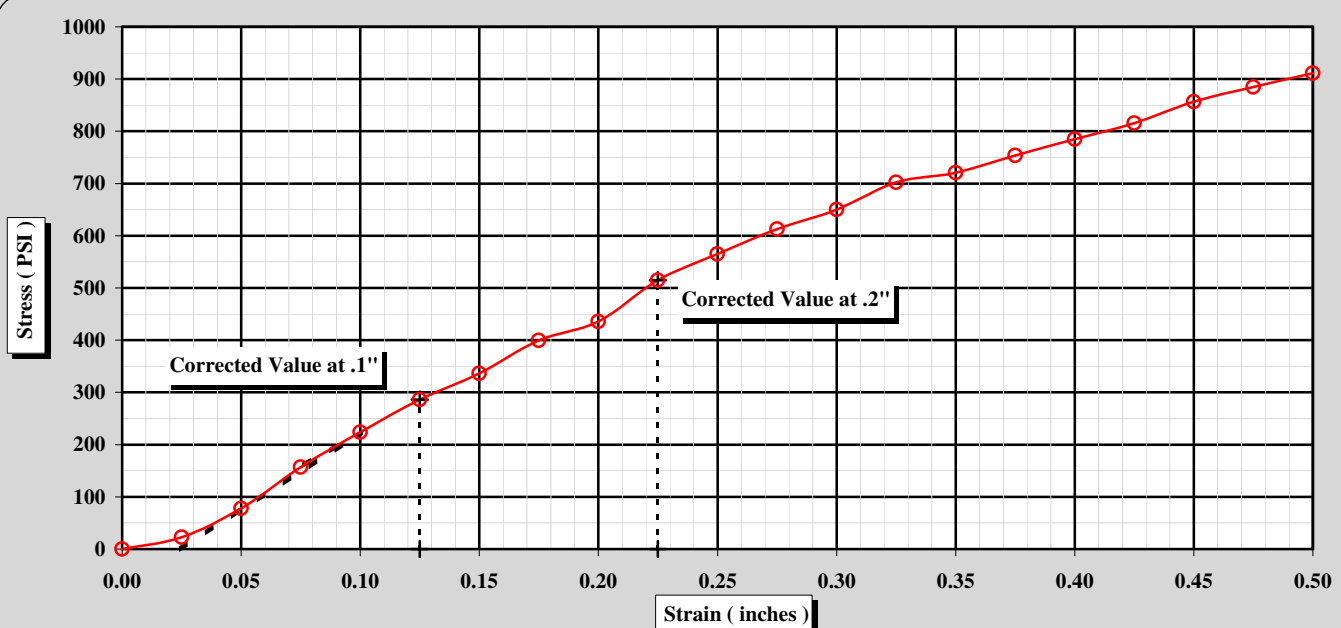
<b>Boring #:</b>	<b>10B01</b>	<b>Sample #:</b>	<b>16926</b>	<b>Sample Date:</b>	<b>1/20/2010</b>
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<b>Type:</b>	<b>Bulk</b>	<b>Depth:</b>	<b>0.5 to 5 feet</b>
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<b>Sample Description:</b>	<b>Brown, clayey SAND (SC)</b>	<b>AASHTO:</b>	<b>A-2-4 (0)</b>
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<b>ASTM D1557 Method A</b>	<b>Maximum Dry Density:</b>	<b>129.5 PCF</b>	<b>Optimum Moisture Content:</b>	<b>9.2%</b>
<b>Compaction Test performed on grading complying with CBR spec.</b>			<b>% Retained on the 3/4" sieve:</b>	<b>0.0%</b>

Uncorrected CBR Values		Corrected CBR Values	
<b>CBR at 0.1 in.</b>	<b>22.4</b>	<b>CBR at 0.1 in.</b>	<b>28.6</b>
<b>CBR at 0.2 in.</b>	<b>29.0</b>	<b>CBR at 0.2 in.</b>	<b>34.3</b>



CBR Sample Preparation:

*The replacement method was used and compacted in a 6" CBR mold in accordance with ASTM D1883, Section 6.1.1*

Before Soaking		After Soaking	
Compactive Effort (Blows per Layer)	56	Final Dry Density (PCF)	127.0
Initial Dry Density (PCF)	130.4	Average Final Moisture Content	10.4%
Moisture Content of the Compacted Specimen	8.6%	Moisture Content (top 1" after soaking)	12.5%
Percent Compaction	100.7%	Percent Swell	1.0%
Soak Time:	144 hrs.	Surcharge Weight	10.0
Liquid Limit	23	Surcharge Wt. per sq. Ft.	51.0
		Plastic Index	14
		Estimated Relative Density	2.700

Notes/Deviations/References:



Form No. TR-D1883-T193-3

Revision No. 1

Revision Date: 9/29/08

**CBR (California Bearing Ratio) of Laboratory  
Compacted Soil**

ASTM D 1883



Quality Assurance

S&amp;ME, Inc. Richmond, 8211 Hermitage Road Richmond, Virginia 23228

<b>Project #:</b>	<b>1081-10-2718</b>	<b>Report Date:</b>	<b>2/9/2010</b>
<b>Project Name:</b>	<b>F-22 Hangar Expansion, Langley AFB, Hampton, VA</b>	<b>Test Date(s)</b>	<b>2/2/10 to 2/8/10</b>
<b>Client Name:</b>	<b>USACE - Norfolk District</b>		

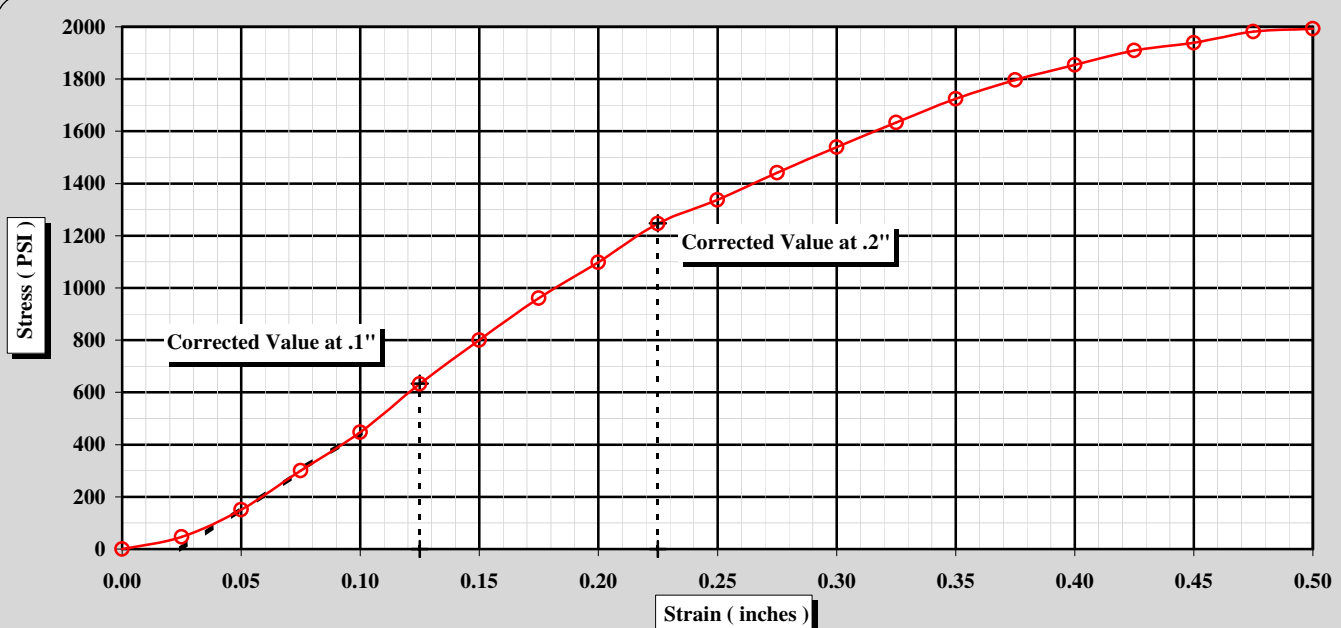
<b>Boring #:</b>	<b>10B02</b>	<b>Sample #:</b>	<b>16931</b>	<b>Sample Date:</b>	<b>1/20/2010</b>
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<b>Type:</b>	<b>Bulk</b>	<b>Depth:</b>	<b>0.5 to 4 feet</b>
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<b>Sample Description:</b>	<b>Brown, clayey SAND (SC)</b>	<b>AASHTO:</b>	<b>A-2-4 (0)</b>
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<b>ASTM D1557 Method A</b>	<b>Maximum Dry Density:</b>	<b>127.2 PCF</b>	<b>Optimum Moisture Content:</b>	<b>9.3%</b>
<b>Compaction Test performed on grading complying with CBR spec.</b>			<b>% Retained on the 3/4" sieve:</b>	<b>0.0%</b>

Uncorrected CBR Values		Corrected CBR Values	
CBR at 0.1 in. 44.7	CBR at 0.2 in. 73.2	CBR at 0.1 in. 63.3	CBR at 0.2 in. 83.1



CBR Sample Preparation:

*The replacement method was used and compacted in a 6" CBR mold in accordance with ASTM D1883, Section 6.1.1*

Before Soaking		After Soaking	
Compactive Effort (Blows per Layer)	56	Final Dry Density (PCF)	122.5
Initial Dry Density (PCF)	124.0	Average Final Moisture Content	9.2%
Moisture Content of the Compacted Specimen	8.0%	Moisture Content (top 1" after soaking)	10.2%
Percent Compaction	97.5%	Percent Swell	0.2%
Soak Time:	144 hrs.	Surcharge Weight	10.0
Liquid Limit	29	Surcharge Wt. per sq. Ft.	51.0
		Plastic Index	19
		Estimated Relative Density	2.700

Notes/Deviations/References:

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

APPENDIX B

List of Drawings Appendix J

<u>Drawing Label</u>	<u>Description/Title</u>
Cover Sheet	Cover Sheet
V-100	Topographic Survey - Key Plan
V-101	Topographic Survey – Existing
CD-100	LO/CR Facility Demolition & Erosion Control Plan
CS-100	LO/CR Facility Site Plan
CG-100	LO/CR Facility Grading & Drainage Plan
CU-100	LO/CR Facility Utility Plan
SCHEME 5	LO/CR Facility Plan, Concept 1, Scheme 5
ELEVATIONS	LO/CR Facility Elevations, Concept 1, Scheme 5
SECTIONS	LO/CR Facility Sections, Concept 1, Scheme 5

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX C Utility Connections

Not Used

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX D

### Results of Fire Flow Tests

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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**Hiller  
Systems  
Inc.**

# Report of Inspection and Testing of Fire Pumps

#1 Not Supplied  
Page 326 of 1022  
Primary 1022

Date: 7-21-09

Property Being Inspected: Bldg # 3A8 LAB3

## A. Inspections (All to be performed weekly)

1. Pump house/room at least 40 degree F? ☐ Yes ☐ No ☐ N/A
2. Pump house/room for diesels w/o engine heaters at least 70 degree F? ☐ Yes ☐ No ☐ N/A
3. Ventilating louvers free to operate? ☐ Yes ☐ No ☐ N/A
4. Suction, discharge and bypass valves open? ☐ Yes ☐ No ☐ N/A
5. Piping free from leaks? ☐ Yes ☐ No ☐ N/A
6. Suction and system pressure gauges normal? ☐ Yes ☐ No ☐ N/A
7. Suction reservoir, if provided, full? ☐ Yes ☐ No ☐ N/A
8. Controller indicating power on? ☐ Yes ☐ No ☐ N/A
9. Transfer switch indicating normal situation? ☐ Yes ☐ No ☐ N/A
10. Isolation switch closed? ☐ Yes ☐ No ☐ N/A
11. Reverse phase alarm indicator off or normal phase rotation indicator on? ☐ Yes ☐ No ☐ N/A
12. Oil level in vertical motor sight normal? ☐ Yes ☐ No ☐ N/A
13. Diesel Engine Inspection
  - a. Fuel tank at least two thirds full? ☐ Yes ☐ No ☐ N/A
  - b. Controller selector switch in Auto position? ☐ Yes ☐ No ☐ N/A
  - c. Battery voltage and readings normal? ☐ Yes ☐ No ☐ N/A
  - d. Battery charging current readings normal? ☐ Yes ☐ No ☐ N/A
  - e. Battery indicators on or failure indicators off? ☐ Yes ☐ No ☐ N/A
  - f. All alarm indicators off? ☐ Yes ☐ No ☐ N/A
  - g. Record engine running time meter reading, is this appropriately higher than previous reading? ☐ Yes ☐ No ☐ N/A
  - h. Oil level in right angle gear drive normal? ☐ Yes ☐ No ☐ N/A
  - i. Crankcase oil level normal? ☐ Yes ☐ No ☐ N/A
  - j. Cooling water level normal? ☐ Yes ☐ No ☐ N/A
  - k. Electrolyte level in batteries normal? ☐ Yes ☐ No ☐ N/A
  - l. Battery terminals free from corrosion? ☐ Yes ☐ No ☐ N/A
  - m. Water jacket heater operating? ☐ Yes ☐ No ☐ N/A
14. Steam pressure gauge for steam driver pump reading normal? ☐ Yes ☐ No ☐ N/A
15. Circulation relief valve flowing water while pump chums? ☐ Yes ☐ No ☐ N/A
16. Pressure relief valve operating w/ proper pressure downstream while pump is operational? ☐ Yes ☐ No ☐ N/A

## B. Tests

### 1. Weekly Test Items

- ☐ Electric motor-Driver pumps
  - ☐ Diesel Engine Driver Pumps
  - ☐ Steam Turbine Driven Pumps
  - A. Pump started automatically? ☐ Yes ☐ No ☐ N/A
  - B. Record Pump starting pressure \_\_\_\_\_ psi
  - C. Record suction \_\_\_\_\_ and discharge \_\_\_\_\_ pressure while running
  - D. Pump run for at least 10 minutes? (Electric) ☐ Yes ☐ No ☐ N/A
  - E. Pump run for at least 30 minutes? (Diesel) ☐ Yes ☐ No ☐ N/A
  - F. Pump packing gland showing slight discharge? ☐ Yes ☐ No ☐ N/A  
adjust if necessary ☐ Yes ☐ No ☐ N/A
  - H. Packing boxes, bearings and pump casing free from over heating? ☐ Yes ☐ No ☐ N/A
  - I. Record time for engine to crank \_\_\_\_\_
  - J. Record time for motor to accelerate to full speed \_\_\_\_\_
  - K. For reduced voltage or reduced current starting, record time controller on first step \_\_\_\_\_
  - L. For automatic stop controllers, record time pump runs after starting \_\_\_\_\_
  - M. Engine oil pressure gauge, speed indicator, water and oil temperature indicators all reading normal?
  - N. Cooling water flowing from heat exchange?
  - O. Record steam pressure gauge reading \_\_\_\_\_
  - P. All times and pressures acceptable? ☐ Yes ☐ No ☐ N/A
- ### 2. Annual Tests
- Annual pump test was run using the following method: (Check one)
- ☐ Method A. Discharge of flow through hose s ☐ Yes ☐ No ☐ N/A at each hose stream
  - ☐ Method B. Discharge through by-pass flow meter to drain or suction reservoir. Flow readings taken by flow meter.
  - ☐ Method C. Discharge through by-pass flow meter directly returned to pump suction. Flow readings taken by flow meter.
- Note: At least once every three years method A or B must be used.

## PUMP NAME PLATE INFORMATION

# 4

## MOTOR NAME PLATE INFORMATION

Fairbanks Morse				Cummins Diesel			
3# 03-87A622				240 HP			
2000 GPM				5# 99486			
1750 RPM							
Approximate percent of rated pump discharge (gpm)	0	25%	50%	75%	100%	125%	150%
Nozzle size (inches)	No Flow				2056		3015
Pitot pressure (psi)	None				13/A		13/A
Flow (gpm)	None				32		44
Pump discharge (psi)					2056		3015
Pump suction (psi)					97		65
Net pump (discharge pressure minus suction pressure)					3		2
Pump speed (rpm)					94		63
Electric voltage & current					1723		1696
					N/A		N/A

- Are the values in the above table acceptable? ☐ Yes ☐ No ☐ N/A
- No-flow (churn) test run for 30 min? ☐ Yes ☐ No ☐ N/A
- Circulation relief valve and pressure relief valve operated properly during all flow tests? ☐ Yes ☐ No ☐ N/A
- No alarm indicators or other visible abnormalities observed during no flow test? ☐ Yes ☐ No ☐ N/A
- ### D. Low Suction Throttling Device Test
1. Low suction pressure simulated? ☐ Yes ☐ No ☐ N/A  
Free from abnormalities in throttling action? ☐ Yes ☐ No ☐ N/A
  2. Free from abnormalities in return to full flow? ☐ Yes ☐ No ☐ N/A

### E. Automatic Transfer Switch Test

1. Power failure simulated during peak flow? ☐ Yes ☐ No ☐ N/A  
Connection made to alternate power source? ☐ Yes ☐ No ☐ N/A
  2. After termination of simulated power failure did motor reconnect to the normal power source? ☐ Yes ☐ No ☐ N/A
- F. All alarm conditions simulated? ☐ Yes ☐ No ☐ N/A
- All alarms operated? ☐ Yes ☐ No ☐ N/A

HSI Rep: Joey Doney

Printed Name: J. Doney

833 Principal Lane - Chesapeake, VA 23320  
Phone (757) 549-9123 - Fax (757) 549-1083

E-Mail: service@hillersystemsinc.com - Website: www.hillersystemsinc.com





**Hiller  
Systems  
Inc.**

# Report of Inspection and Testing of Fire Pumps

[Not Supplied]

Page 327 of 1092

Date: 7-21-09

Property Being Inspected:

Bldg # 348 LAPB

**A. Inspections (All to be performed weekly)**

1. Pump house/room at least 40 degree F? ☐ Yes ☐ No ☐ N/A
2. Pump house/room for diesels w/o engine heaters at least 70 degree F? ☐ Yes ☐ No ☐ N/A
3. Ventilating louvers free to operate? ☐ Yes ☐ No ☐ N/A
4. Suction, discharge and bypass valves open? ☐ Yes ☐ No ☐ N/A
5. Piping free from leaks? ☐ Yes ☐ No ☐ N/A
6. Suction and system pressure gauges normal? ☐ Yes ☐ No ☐ N/A
7. Suction reservoir, if provided, full? ☐ Yes ☐ No ☐ N/A
8. Controller indicating power on? ☐ Yes ☐ No ☐ N/A
9. Transfer switch indicating normal situation? ☐ Yes ☐ No ☐ N/A
10. Isolation switch closed? ☐ Yes ☐ No ☐ N/A
11. Reverse phase alarm indicator off or normal phase rotation indicator on? ☐ Yes ☐ No ☐ N/A
12. Oil level in vertical motor sight normal? ☐ Yes ☐ No ☐ N/A
13. Diesel Engine Inspection
  - a. Fuel tank at least two thirds full? ☐ Yes ☐ No ☐ N/A
  - b. Controller selector switch in Auto position? ☐ Yes ☐ No ☐ N/A
  - c. Battery voltage and readings normal? ☐ Yes ☐ No ☐ N/A
  - d. Battery charging current readings normal? ☐ Yes ☐ No ☐ N/A
  - e. Battery indicators on or failure indicators off? ☐ Yes ☐ No ☐ N/A
  - f. All alarm indicators off? ☐ Yes ☐ No ☐ N/A
  - g. Record engine running time meter reading, \_\_\_\_\_ is this appropriately higher than previous reading? ☐ Yes ☐ No ☐ N/A
  - h. Oil level in right angle gear drive normal? ☐ Yes ☐ No ☐ N/A
  - i. Crankcase oil level normal? ☐ Yes ☐ No ☐ N/A
  - j. Cooling water level normal? ☐ Yes ☐ No ☐ N/A
  - k. Electrolyte level in batteries normal? ☐ Yes ☐ No ☐ N/A
  - l. Battery terminals free from corrosion? ☐ Yes ☐ No ☐ N/A
  - m. Water jacket heater operating? ☐ Yes ☐ No ☐ N/A
14. Steam pressure gauge for steam driver pump reading normal? ☐ Yes ☐ No ☐ N/A
15. Circulation relief valve flowing water while pump churns? ☐ Yes ☐ No ☐ N/A
16. Pressure relief valve operating w/ proper pressure downstream while pump is operational? ☐ Yes ☐ No ☐ N/A

**B. Tests****1. Weekly Test Items**

- ☐ Electric motor-Driver pumps
- ☐ Diesel Engine Driver Pumps
- ☐ Steam Turbine Driven Pumps
- A. Pump started automatically? ☐ Yes ☐ No ☐ N/A
- B. Record Pump starting pressure \_\_\_\_\_ psi
- C. Record suction \_\_\_\_\_ and discharge \_\_\_\_\_ pressure while running
- D. Pump run for at least 10 minutes? (Electric) ☐ Yes ☐ No ☐ N/A
- E. Pump run for at least 30 minutes? (Diesel) ☐ Yes ☐ No ☐ N/A
- F. Pump packing gland showing slight discharge? ☐ Yes ☐ No ☐ N/A  
adjust if necessary ☐ Yes ☐ No ☐ N/A
- H. Packing boxes, bearings and pump casing free from over heating? ☐ Yes ☐ No ☐ N/A
- I. Record time for engine to crank \_\_\_\_\_
- J. Record time for motor to accelerate to full speed \_\_\_\_\_
- K. For reduced voltage or reduced current starting, record time controller on first step \_\_\_\_\_
- L. For automatic stop controllers, record time pump runs after starting \_\_\_\_\_
- M. Engine oil pressure gauge, speed indicator, water and oil temperature indicators all reading normal?
- N. Cooling water flowing from heat exchange?
- O. Record steam pressure gauge reading \_\_\_\_\_
- P. All times and pressures acceptable? ☐ Yes ☐ No ☐ N/A

**2. Annual Tests**

Annual pump test was run using the following method: (Check one)

- ☐ Method A. Discharge of flow through hose s ☐ Yes ☐ No ☐ N/A at each hose stream
- ☐ Method B. Discharge through by-pass flow meter to drain or suction reservoir. Flow readings taken by flow meter.
- ☐ Method C. Discharge through by-pass flow meter directly returned to pump suction. Flow readings taken by flow meter.

Note: At least once every three years method A or B must be used.

**PUMP NAME PLATE INFORMATION****MOTOR NAME PLATE INFORMATION**

Fairbanks Morse				Cummins Diesel			
S# KSE1011866-1				240 HP			
2000 GPM				S# A8105			
1750 RPM							
Approximate percent of rated pump discharge (gpm)	0	25%	50%	75%	100%	125%	150%
Nozzle size (Inches)	No Flow				2056		3015
Pitot pressure (psi)	None				13/4		13/4
Flow (gpm)	None				32x A		44x5
Pump discharge (psi)					2056		3015
Pump suction (psi)					100		64
Net pump (discharge pressure minus suction pressure)					2		2
Pump speed (rpm)					98		62
Electric voltage & current					1756		1742
					N/A		N/A

- Are the values in the above table acceptable? ☐ Yes ☐ No ☐ N/A
- No-flow (churn) test run for 30 min? ☐ Yes ☐ No ☐ N/A
- Circulation relief valve and pressure relief valve operated properly during all flow tests? ☐ Yes ☐ No ☐ N/A
- No alarm indicators or other visible abnormalities observed during no flow test? ☐ Yes ☐ No ☐ N/A
- D. Low Suction Throttling Device Test**
1. Low suction pressure simulated? ☐ Yes ☐ No ☐ N/A
  - Free from abnormalities in throttling action? ☐ Yes ☐ No ☐ N/A
  2. Free from abnormalities in return to full flow? ☐ Yes ☐ No ☐ N/A

**E. Automatic Transfer Switch Test**

1. Power failure simulated during peak flow? ☐ Yes ☐ No ☐ N/A
- Connection made to alternate power source? ☐ Yes ☐ No ☐ N/A
2. After termination of simulated power failure did motor reconnect to the normal power source? ☐ Yes ☐ No ☐ N/A
- F. All alarm conditions simulated? ☐ Yes ☐ No ☐ N/A
- All alarms operated? ☐ Yes ☐ No ☐ N/A

HSI Rep:

Printed Name:

833 Principal Lane - Chesapeake, VA 23320

Phone (757) 549-9123 - Fax (757) 549-1083

E-Mail: service@hillersystemsinc.com - Website: www.hillersystemsinc.com

(Page 1 of 2)

F-104

Tuesday, July 13, 2010



**Hiller  
Systems  
Inc.**

# Report of Inspection and Testing of Fire Pumps

# [Not Supplied]  
Page 328 of 1092

Property Being Inspected:

Bldg # 3A8 LAB

Date: 7-21-09

## A. Inspections (All to be performed weekly)

1. Pump house/room at least 40 degree F? ☐ Yes ☐ No ☐ N/A
2. Pump house/room for diesels w/o engine heaters at least 70 degree F? ☐ Yes ☐ No ☐ N/A
3. Ventilating louvers free to operate? ☐ Yes ☐ No ☐ N/A
4. Suction, discharge and bypass valves open? ☐ Yes ☐ No ☐ N/A
5. Piping free from leaks? ☐ Yes ☐ No ☐ N/A
6. Suction and system pressure gauges normal? ☐ Yes ☐ No ☐ N/A
7. Suction reservoir, if provided, full? ☐ Yes ☐ No ☐ N/A
8. Controller indicating power on? ☐ Yes ☐ No ☐ N/A
9. Transfer switch indicating normal situation? ☐ Yes ☐ No ☐ N/A
10. Isolation switch closed? ☐ Yes ☐ No ☐ N/A
11. Reverse phase alarm indicator off or normal phase rotation indicator on? ☐ Yes ☐ No ☐ N/A
12. Oil level in vertical motor sight normal? ☐ Yes ☐ No ☐ N/A
13. Diesel Engine Inspection
  - a. Fuel tank at least two thirds full? ☐ Yes ☐ No ☐ N/A
  - b. Controller selector switch in Auto position? ☐ Yes ☐ No ☐ N/A
  - c. Battery voltage and readings normal? ☐ Yes ☐ No ☐ N/A
  - d. Battery charging current readings normal? ☐ Yes ☐ No ☐ N/A
  - e. Battery indicators on or failure indicators off? ☐ Yes ☐ No ☐ N/A
  - f. All alarm indicators off? ☐ Yes ☐ No ☐ N/A
  - g. Record engine running time meter reading, \_\_\_\_\_ is this appropriately higher than previous reading? ☐ Yes ☐ No ☐ N/A
  - h. Oil level in right angle gear drive normal? ☐ Yes ☐ No ☐ N/A
  - i. Crankcase oil level normal? ☐ Yes ☐ No ☐ N/A
  - j. Cooling water level normal? ☐ Yes ☐ No ☐ N/A
  - k. Electrolyte level in batteries normal? ☐ Yes ☐ No ☐ N/A
  - l. Battery terminals free from corrosion? ☐ Yes ☐ No ☐ N/A
  - m. Water jacket heater operating? ☐ Yes ☐ No ☐ N/A
14. Steam pressure gauge for steam driver pump reading normal? ☐ Yes ☐ No ☐ N/A
15. Circulation relief valve flowing water while pump churns? ☐ Yes ☐ No ☐ N/A
16. Pressure relief valve operating w/ proper pressure downstream while pump is operational? ☐ Yes ☐ No ☐ N/A

## B. Tests

### 1. Weekly Test Items

- ☐ Electric motor-Driver pumps
- ☐ Diesel Engine Driver Pumps
- ☐ Steam Turbine Driven Pumps
- A. Pump started automatically? ☐ Yes ☐ No ☐ N/A
- B. Record Pump starting pressure \_\_\_\_\_ psi
- C. Record suction \_\_\_\_\_ and discharge \_\_\_\_\_ pressure while running
- D. Pump run for at least 10 minutes? (Electric) ☐ Yes ☐ No ☐ N/A
- E. Pump run for at least 30 minutes? (Diesel) ☐ Yes ☐ No ☐ N/A
- F. Pump packing gland showing slight discharge? ☐ Yes ☐ No ☐ N/A  
adjust if necessary ☐ Yes ☐ No ☐ N/A
- H. Packing boxes, bearings and pump casing free from over heating? ☐ Yes ☐ No ☐ N/A
- I. Record time for engine to crank, \_\_\_\_\_
- J. Record time for motor to accelerate to full speed \_\_\_\_\_
- K. For reduced voltage or reduced current starting, record time controller on first step \_\_\_\_\_
- L. For automatic stop controllers, record time pump runs after starting \_\_\_\_\_
- M. Engine oil pressure gauge, speed indicator, water and oil temperature indicators all reading normal?
- N. Cooling water flowing from heat exchange?
- O. Record steam pressure gauge reading \_\_\_\_\_
- P. All times and pressures acceptable? ☐ Yes ☐ No ☐ N/A

### 2. Annual Tests

Annual pump test was run using the following method: (Check one)

- ☐ Method A. Discharge of flow through hose & \_\_\_\_\_ at each hose stream ☐ Yes ☐ No ☐ N/A
- ☐ Method B. Discharge through by-pass flow meter to drain or suction reservoir. Flow readings taken by flow meter.
- ☐ Method C. Discharge through by-pass flow meter directly returned to pump suction. Flow readings taken by flow meter.

Note: At least once every three years method A or B must be used.

## PUMP NAME PLATE INFORMATION

## MOTOR NAME PLATE INFORMATION

Fairbanks Morse				Cummins Diesel			
SA K3E10118 66-2				A880C			
2000 GPM				240 HP			
1750 RPM							
Approximate percent of rated pump discharge (gpm)	0	25%	50%	75%	100%	125%	150%
No Flow					2056		3014
Nozzle size (Inches)	None				1 3/4		1 3/4
Pitot pressure (psi)	None				32 x A		44 x 5
Flow (gpm)	None				2056		3014
Pump discharge (psi)					98		60
Pump suction (psi)					2		2
Net pump (discharge pressure minus suction pressure)					96		58
Pump speed (rpm)					1762		1741
Electric voltage & current					N/A		N/A

- Are the values in the above table acceptable? ☐ Yes ☐ No ☐ N/A
- No-flow (churn) test run for 30 min? ☐ Yes ☐ No ☐ N/A
- Circulation relief valve and pressure relief valve operated properly during all flow tests? ☐ Yes ☐ No ☐ N/A
- No alarm indicators or other visible abnormalities observed during no flow test? ☐ Yes ☐ No ☐ N/A

## D. Low Suction Throttling Device Test

1. Low suction pressure simulated? ☐ Yes ☐ No ☐ N/A
- Free from abnormalities in throttling action? ☐ Yes ☐ No ☐ N/A
2. Free from abnormalities in return to full flow? ☐ Yes ☐ No ☐ N/A

## E. Automatic Transfer Switch Test

1. Power failure simulated during peak flow? ☐ Yes ☐ No ☐ N/A
- Connection made to alternate power source? ☐ Yes ☐ No ☐ N/A
2. After termination of simulated power failure did motor reconnect to the normal power source? ☐ Yes ☐ No ☐ N/A
- F. All alarm conditions simulated? ☐ Yes ☐ No ☐ N/A
- All alarms operated? ☐ Yes ☐ No ☐ N/A

HSI Rep: Joey Dany

Printed Name: J. M. L.

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**Hiller  
Systems  
Inc.**

# Report of Inspection and Testing of Fire Pumps

41 (Not Supplied)  
Page 329 of 1092

Property Being Inspected:

PLD, A 348 LAB

Date: 7-21-09**A. Inspections (All to be performed weekly)**

1. Pump house/room at least 40 degree F? ☐ Yes ☐ No ☐ N/A
2. Pump house/room for diesels w/o engine heaters at least 70 degree F? ☐ Yes ☐ No ☐ N/A
3. Ventilating louvers free to operate? ☐ Yes ☐ No ☐ N/A
4. Suction, discharge and bypass valves open? ☐ Yes ☐ No ☐ N/A
5. Piping free from leaks? ☐ Yes ☐ No ☐ N/A
6. Suction and system pressure gauges normal? ☐ Yes ☐ No ☐ N/A
7. Suction reservoir, if provided, full? ☐ Yes ☐ No ☐ N/A
8. Controller indicating power on? ☐ Yes ☐ No ☐ N/A
9. Transfer switch indicating normal situation? ☐ Yes ☐ No ☐ N/A
10. Isolation switch closed? ☐ Yes ☐ No ☐ N/A
11. Reverse phase alarm indicator off or normal phase rotation indicator on? ☐ Yes ☐ No ☐ N/A
12. Oil level in vertical motor sight normal? ☐ Yes ☐ No ☐ N/A
13. Diesel Engine Inspection
  - a. Fuel tank at least two thirds full? ☐ Yes ☐ No ☐ N/A
  - b. Controller selector switch in Auto position? ☐ Yes ☐ No ☐ N/A
  - c. Battery voltage and readings normal? ☐ Yes ☐ No ☐ N/A
  - d. Battery charging current readings normal? ☐ Yes ☐ No ☐ N/A
  - e. Battery indicators on or failure indicators off? ☐ Yes ☐ No ☐ N/A
  - f. All alarm indicators off? ☐ Yes ☐ No ☐ N/A
  - g. Record engine running time meter reading.                      Is this                       
appropriately higher than previous reading? ☐ Yes ☐ No ☐ N/A
  - h. Oil level in right angle gear drive normal? ☐ Yes ☐ No ☐ N/A
  - i. Crankcase oil level normal? ☐ Yes ☐ No ☐ N/A
  - j. Cooling water level normal? ☐ Yes ☐ No ☐ N/A
  - k. Electrolyte level in batteries normal? ☐ Yes ☐ No ☐ N/A
  - l. Battery terminals free from corrosion? ☐ Yes ☐ No ☐ N/A
  - m. Water jacket heater operating? ☐ Yes ☐ No ☐ N/A
14. Steam pressure gauge for steam driver pump reading normal? ☐ Yes ☐ No ☐ N/A
15. Circulation relief valve flowing water while pump churns? ☐ Yes ☐ No ☐ N/A
16. Pressure relief valve operating w/ proper pressure downstream while pump is operational? ☐ Yes ☐ No ☐ N/A

**B. Tests****1. Weekly Test Items**

- ☐ Electric motor-Driven pumps
  - ☐ Diesel Engine Driven Pumps
  - ☐ Steam Turbine Driven Pumps
  - A. Pump started automatically? ☐ Yes ☐ No ☐ N/A
  - B. Record Pump starting pressure                      psi
  - C. Record suction                      and discharge                      pressure while running
  - D. Pump run for at least 10 minutes? (Electric) ☐ Yes ☐ No ☐ N/A
  - E. Pump run for at least 30 minutes? (Diesel) ☐ Yes ☐ No ☐ N/A
  - F. Pump packing gland showing slight discharge?                       
adjust if necessary ☐ Yes ☐ No ☐ N/A
  - H. Packing boxes, bearings and pump casing free from over heating? ☐ Yes ☐ No ☐ N/A
  - I. Record time for engine to crank.
  - J. Record time for motor to accelerate to full speed
  - K. For reduced voltage or reduced current starting, record time controller on first step.
  - L. For automatic stop controllers, record time pump runs after starting
  - M. Engine oil pressure gauge, speed indicator, water and oil temperature indicators all reading normal?
  - N. Cooling water flowing from heat exchange?
  - O. Record steam pressure gauge reading
  - P. All times and pressures acceptable? ☐ Yes ☐ No ☐ N/A
- 2. Annual Tests**
- Annual pump test was run using the following method: (Check one)
- ☐ Method A. Discharge of flow through hose s ☐ Yes ☐ No ☐ N/A  
at each hose stream
  - ☐ Method B. Discharge through by-pass flow meter to drain or suction reservoir. Flow readings taken by flow meter.
  - ☐ Method C. Discharge through by-pass flow meter directly returned to pump suction. Flow readings taken by flow meter.
- Note: At least once every three years method A or B must be used.

**PUMP NAME PLATE INFORMATION****MOTOR NAME PLATE INFORMATION**

<u>Fairbank Morse</u>				<u>Cummins Diesel</u>			
<u>SA K3E 1011866-3</u>				<u>48105</u>			
<u>2000 GPM</u>				<u>240 AMP</u>			
<u>1750 RPM</u>							
Approximate percent of rated pump discharge (gpm)	0	25%	50%	75%	100%	125%	150%
No-flow (churn) test run for 30 min?	No Flow				2056		3014
Nozzle size (inches)	None				1 3/4		1 3/4
Pitot pressure (psi)	None				32 x 4		44 x 5
Flow (gpm)	None				2056		3014
Pump discharge (psi)					94		58
Pump suction (psi)					2		2
Net pump (discharge pressure minus suction pressure)					92		56
Pump speed (rpm)					1736		1721
Electric voltage & current					N/A		N/A

- Are the values in the above table acceptable? ☐ Yes ☐ No ☐ N/A
- No-flow (churn) test run for 30 min? ☐ Yes ☐ No ☐ N/A
- Circulation relief valve and pressure relief valve operated properly during all flow tests? ☐ Yes ☐ No ☐ N/A
- No alarm indicators or other visible abnormalities observed during no flow test? ☐ Yes ☐ No ☐ N/A
- D. Low Suction Throttling Device Test**
1. Low suction pressure simulated? ☐ Yes ☐ No ☐ N/A  
Free from abnormalities in throttling action? ☐ Yes ☐ No ☐ N/A
  2. Free from abnormalities in return to full flow? ☐ Yes ☐ No ☐ N/A

**E. Automatic Transfer Switch Test**

1. Power failure simulated during peak flow? ☐ Yes ☐ No ☐ N/A  
Connection made to alternate power source? ☐ Yes ☐ No ☐ N/A
  2. After termination of simulated power failure did motor reconnect to the normal power source? ☐ Yes ☐ No ☐ N/A
- F. All alarm conditions simulated? ☐ Yes ☐ No ☐ N/A
- All alarms operated? ☐ Yes ☐ No ☐ N/A

HSI Rep: Joey D...Printed Name: Joey D...

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Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX E

### Environmental Information

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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**LIMITED ENVIRONMENTAL INVESTIGATION  
F22 HANGAR EXPANSION  
LANGLEY AIR FORCE BASE  
HAMPTON, VIRGINIA**  
S&ME Project No. 1081-10-2718

Prepared for:  
United States Corp of Engineers  
Norfolk, Virginia

Prepared by:  
S&ME, Inc.  
Richmond, Virginia

February 19, 2010





February 19, 2010

United States Army Corp. of Engineers  
803 Front Street  
Norfolk, Virginia 23510-1096

Attention: Marc Gutterman

**Reference: Limited Environmental Investigation**  
F-22 Hangar Expansion  
Langley Air Force Base  
Hampton, Virginia  
S&ME Project No. 1081-10-2718

Dear Marc:

This limited environmental investigation presents the results of Geoprobe subsurface explorations by S&ME, Inc. for the proposed F-22 Hangar Expansion at Langley Air Force Base in Hampton, Virginia.

This report describes our understanding of the project, presents the results of environmental field exploration and subcontract laboratory testing, and a brief discussion of results. We are submitting the Preliminary Geotechnical Engineering Report, dated February 18, 2010, under separate cover.

S&ME appreciates this opportunity to be of service to you. Please let us know if you have questions concerning this report or any of our services.

Respectfully submitted,

**S&ME, Inc. | Richmond Branch**

A handwritten signature in blue ink that reads "Tara D. Mason".

Tara D. Mason  
Staff Scientist

A handwritten signature in blue ink that reads "David M. Sayre".

David M. Sayre, P.G.  
Environmental Services Manager

x:\gt\gt2701 to 2800\gt2718 f-22 hangar - usace\environmental\limited environmental investigation report.doc



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1. Introduction..... 1

2. Field Activities..... 1

3. Results..... 2

4. Conclusions..... 3

5. Limitations..... 3

- Appendix I – Drawings
- Appendix II – Boring Logs
- Appendix III – Laboratory Data



## 1. INTRODUCTION

S&ME, Inc. (S&ME) is pleased to submit our report of limited environmental investigation to the United States Army Corp of Engineers (USACE) for the proposed F-22 Hanger Expansion at Langley Air Force Base (AFB) in Hampton, Virginia (Appendix I, Drawing 1). S&ME completed our services in accordance with:

- S&ME's Proposal for Preliminary Geotechnical Engineering and Environmental Sampling Services (PR09231, Revision 2) dated December 18, 2009 (Environmental Sampling and Testing Scope of Services)

The objective of our environmental scope was to investigate soil contamination in the upper eight feet of the expansion area at ten locations. Based on elevated VOC readings, we proposed to select one sample from each boring for chemical analysis. If no elevated readings were observed, we proposed to select a sample from the upper four feet of the boring.

## 2. FIELD ACTIVITIES

An S&ME geologist visited the site on January 20, 2010 with subcontract Geoprobe driller, Conetec. S&ME observed Conetec advance 10 geoprobe borings to a target depth of approximately 8 feet.

S&ME logged and documented soil conditions on our report of boring log forms included in Appendix II of this report. Our sample locations are shown on Drawing 2 in Appendix I. S&ME screened the soil using a MiniRae Photoionization Detector (PID) for isobutylene equivalent VOC concentrations and recorded observations on our boring logs.

The following table provides the sample IDs, total depth and sample interval. Water was encountered in 6 of the 10 borings. We were not able to retrieve soil to 8 feet in several borings due to no recovery and/or obstructions at the intervals specified in Table 1.

**Table 1. Boring Identification**

Exploration Designation <sup>1</sup>	Sample ID/Interval	Depth of Boring
10GP01	10GP01 1 to 4 ft	8
10GP02	10GP02 1.3 to 3.5 ft	7.2
10GP03	10GP03 2.1 to 3.4 ft	6.1
10GP04	10GP04 2 to 4 ft	8
10GP05	10GP05 2 to 3.3 ft	5.6
10GP06	10GP06 2 to 4 ft	5.1
10GP07	10GP07 2.5 to 4 ft	8
10GP08	10GP08 2 to 4 ft	8

Exploration Designation <sup>1</sup>	Sample ID/Interval	Depth of Boring
10GP09	10GP09 2 to 4 ft	6
10GP10	10GP10 2 to 4 ft	5.6

The PID did not detect concentrations of VOCs, therefore S&ME selected soil from intervals in the upper four feet of each boring and placed the soil into laboratory provided glassware. The samples were placed immediately on ice. We maintained chain of custody of the samples and submitted the samples to a DoD ELAP approved laboratory (Test America Savannah, Georgia) for the analyses listed in Table 2.

**Table 2. Chemical Analytical Method**

Chemical Analytical Method
SW846 EPA Method 8015B Total Petroleum Hydrocarbons - Gasoline Range Organics – (TPH-GRO)
SW846 EPA Method 8260B BTEX (benzene, toluene, ethylbenzene, xylenes)
SW846 EPA Method 9023 Organic Halides, Extractable (EOX)
SW846 EPA Method 6020 Priority Pollutant Metals
SW846 EPA Method Total Petroleum Hydrocarbons - Diesel Range 8015B (TPH-DRO)

### 3. RESULTS

Detected concentrations of analytes are tabulated in Appendix III. The following compounds were detected in at least one soil sample as shown on the tabulated data tables.

**Table 3. Detected Compounds**

Analytical Method	Compound
6020	Arsenic
	Beryllium
	Cadmium
	Chromium
	Copper
	Lead
	Nickel
	Thallium
	Zinc
8015B	Diesel Range Organics
	Gasoline Range Organics (GRO)
9023	Halogen, Extractable Organic

The full laboratory data report is also included in Appendix III including QA/QC data.

#### **4. CONCLUSIONS**

We compared concentrations of the detected compounds to EPA risk based screening levels for industrial users (if established) and highlighted the cells where there were observed exceedances. Arsenic concentrations in the ten samples exceeded the EPA SL. Arsenic is a naturally occurring element and natural concentrations often exceed the EPA SL in soil samples collected in Virginia. The other detected metals were below the associated screening levels. Detected concentrations of total petroleum hydrocarbons in the diesel range (TPH-DRO) exceeded 100 mg/kg in 2 of the 10 soil samples. DEQ considers concentrations greater than 100 mg/kg a reportable release.

There were no detected concentrations of BTEX compounds, total petroleum hydrocarbons in the gasoline range (TPH-GRO), antimony, mercury, silver, or selenium in the ten samples.

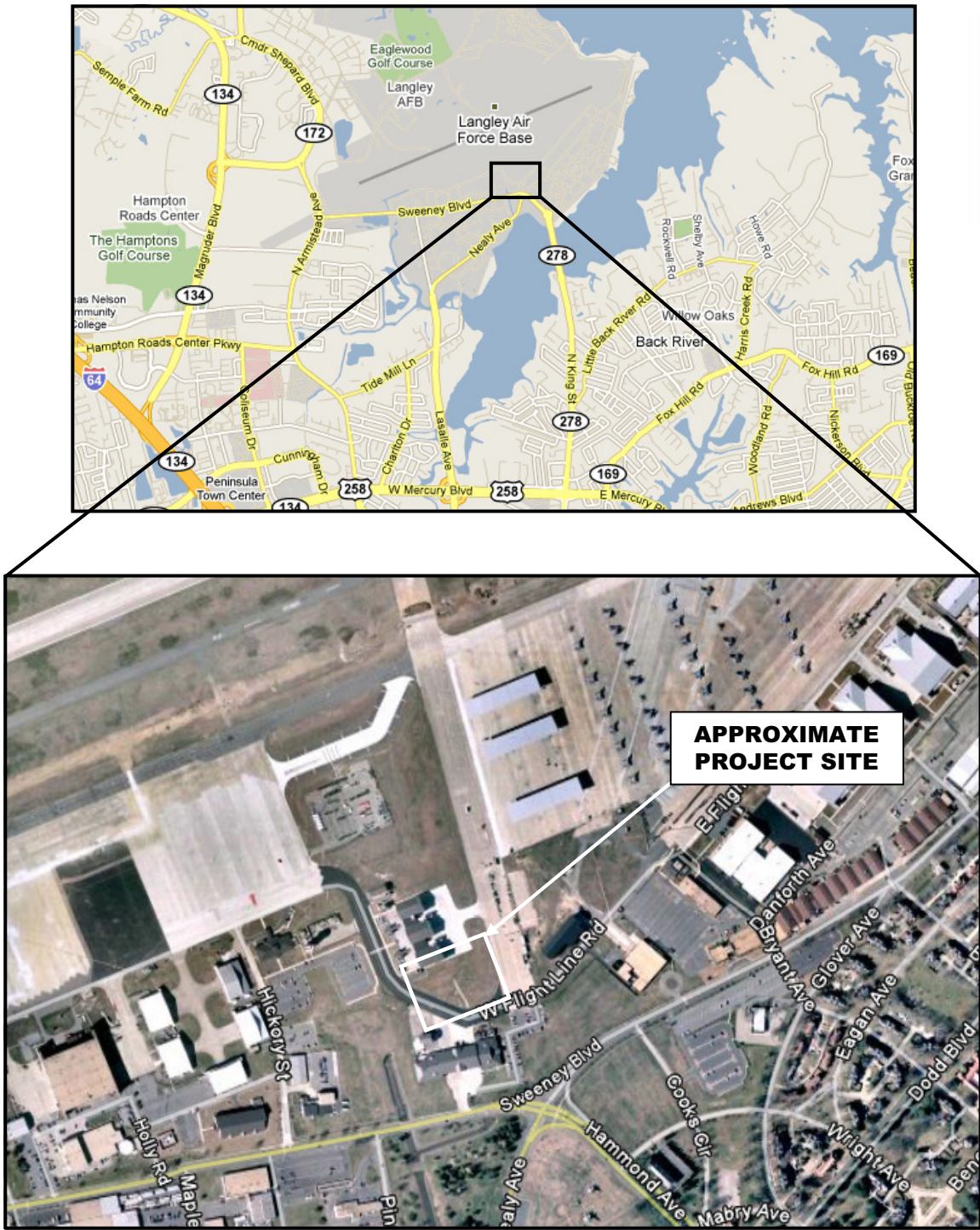
#### **5. LIMITATIONS**

We chose the soil sampling locations to be in the most likely impacted areas of each boring in locations specified by the client. We selected the chemical analyses performed based upon client requirements provided.




## **APPENDIX I**

### Drawings



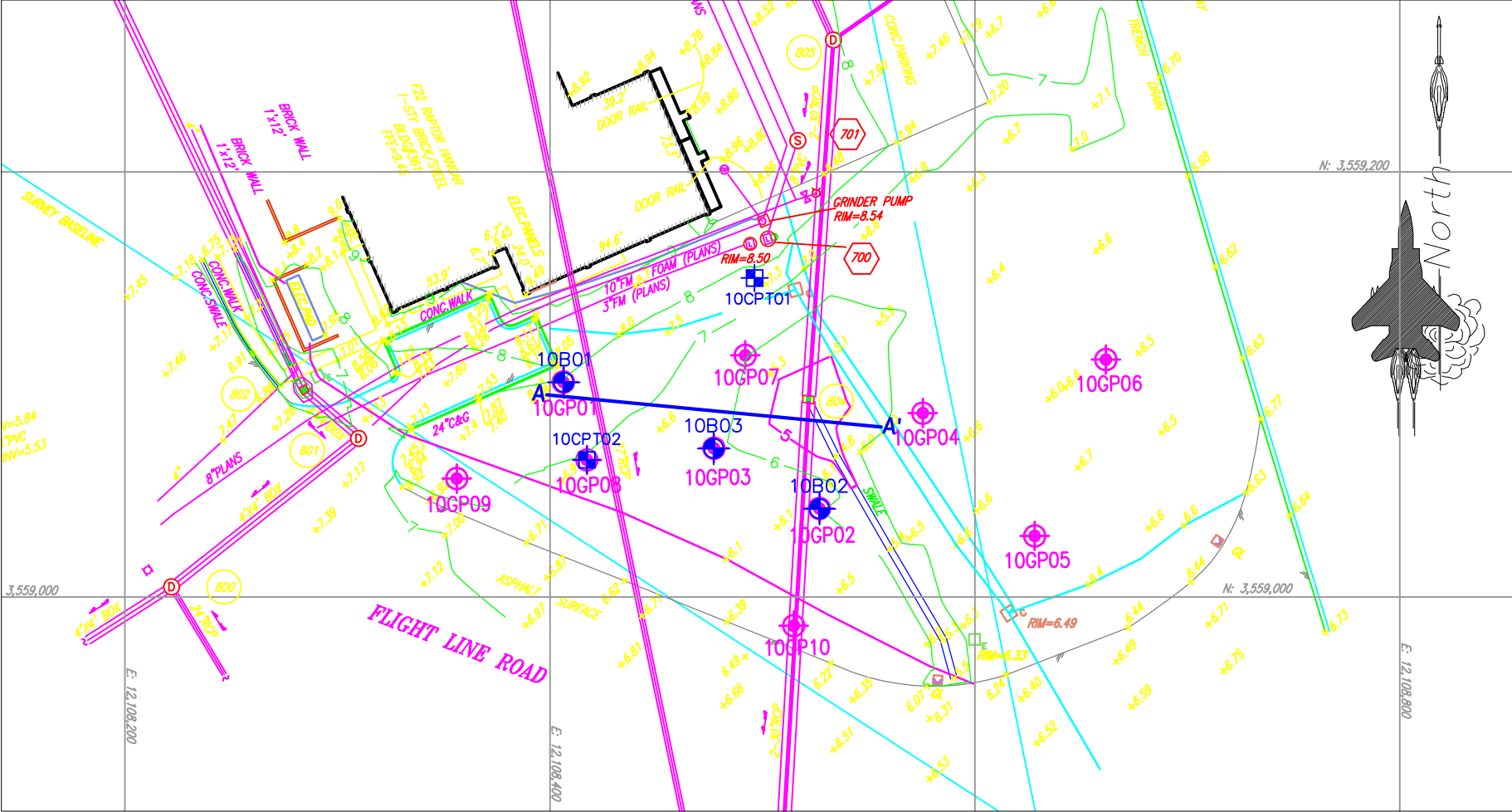
NOTE:  
UPPER MAP CREATED USING GOOGLE MAPS.  
LOWER MAP CREATED USING GOOGLE  
EARTH.



1081-10-2718  
F-22 HANGAR EXPANSION  
LANGLEY AIR FORCE BASE  
HAMPTON, VIRGINIA

SITE VICINITY MAP

PREPARED BY:	REVIEWED BY:	DRAWING  1
DRAFTER: AFS	SCALE: NONE	



NOTES:

- 1. THE BASE PLAN FOR THIS DRAWING WAS PROVIDED BY THE USACE ON FEBRUARY 12, 2010.
- 2. CONETEC OF CHARLES CITY, VIRGINIA COMPLETED TWO CONE PENETRATION TEST (CPT) SOUNDINGS AND TEN GEOPROBES (GP) AND FISHBURNE DRILLING, INC. OF CHESAPEAKE, VIRGINIA COMPLETED THREE STANDARD PENETRATION TEST (SPT) BORINGS AT THE PROJECT SITE ON JANUARY 20, 2010. S&ME PERSONNEL MONITORED THE EXPLORATIONS IN THE FIELD AND PREPARED LOGS OF THE TEST BORINGS AND GEOPROBES.
- 3. LOCATIONS OF THE SUBSURFACE EXPLORATIONS SHOWN ON THE DRAWING ARE APPROXIMATE AND WERE SURVEYED BY PRECISION MEASUREMENTS AFTER S&ME COMPLETED THE FIELD EXPLORATIONS.

- 10B01 STANDARD PENETRATION TEST (SPT) BORING DESIGNATION AND APPROXIMATE LOCATION.
- 10CPT01 CONE PENETRATION TEST (CPT) SOUNDINGS DESIGNATION AND APPROXIMATE LOCATION.
- 10GP07 GEOPROBE (GP) DESIGNATION AND APPROXIMATE LOCATION.

SCALE: AS SHOWN	DATE: FEB. 2010	 WWW.SMEINC.COM	APPROXIMATE SUBSURFACE EXPLORATION LOCATION PLAN F-22 HANGAR EXPANSION LANGLEY AFB, HAMPTON, VIRGINIA	DRAWING
PROJECT NO. 1081-10-2718	DRAWN BY: AFS			2
	CHECKED BY:			

Tuesday, July 13, 2010



## **APPENDIX II**

### Boring Logs

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,101.1 E 12,108,406.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP01				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 8.0				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+8.0 ±	
9. TOTAL DEPTH OF HOLE 8.0				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST		Matthew Thornton	
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Orange-brown, fine to coarse SAND, with some clay and trace gravel, moist			PID Reading = 0 from a depth of 0 to 8 feet.	
			[SC] Orange-brown and black, fine to coarse SAND, with some clay and trace gravel, moist.			Environmental Sample collected from a depth of 1 to 4 feet	
			[CL] Orange-brown mottled with gray, Sandy lean CLAY, moist.			Clayey GRAVEL lense from an approximate depth of 2.3 to 2.6 feet beneath the existing ground surface.	
2	6.0					FILL	
0	8.0					STRATUM 1	
			Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.				



DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,041.6 E 12,108,526.9				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP02				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 7.2				17. ELEVATION TOP OF HOLE +6.0 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 7.2							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Orange-brown and black, fine to coarse SAND, with some clay and trace gravel, moist.			PID Reading = 0 from a depth of 0 to 7.2 feet.	
2.5	3.5		[CL] Orange-brown mottled with gray, lean CLAY SAND, with some sand and trace gravel, moist.			Environmental Sample collected from a depth of 1.3 to 3.5 feet	
0	6.0		[SC] Orange-brown mottled with gray, fine to medium SAND, with some clay, wet.			FILL	
-1.2	7.2		No Recovery			STRATUM 1	
-2	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.				

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,070.0 E 12,108,477.2				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP03				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 6.1				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+6.3 ±	
9. TOTAL DEPTH OF HOLE 6.1				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST		Matthew Thornton	
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown, Clayey fine to coarse SAND, moist.			PID Reading = 0 from a depth of 0 to 6.1 feet.	
			[SC] Brown and gray-brown mottled with orange-brown, Clayey fine to coarse SAND, with trace gravel, moist.			Environmental Sample collected from a depth of 2.1 to 3.4 feet	
1.3	5.0		[SC] Orange-brown mottled with gray, Clayey fine to coarse SAND, moist.			Fill	
0.2	6.1		No Recovery				
-1.7	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,086.0 E 12,108,577.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP04				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 8.0				17. ELEVATION TOP OF HOLE +6.5 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 8.0							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
6.2	0.3	[SC] Brown, fine to medium SAND, with some clay, moist.				PID Reading = 0 from a depth of 0 to 8 feet.	
5.8	0.7	[SP-SC] Gray, fine to coarse SAND, with little clay and little gravel, moist.				Environmental Sample collected from a depth of 2 to 4 feet	
		[SC] Light brown and orange-brown, Clayey fine to coarse SAND, with trace gravel, moist.				FILL	
1.4	5.1	[SC] Orange-brown and gray, fine to medium SAND and clay, wet.				STRATUM 1	
-1.5	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.				

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,028.3 E 12,108,628.0				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP05				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 5.6				17. ELEVATION TOP OF HOLE +6.6 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 5.6							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
4.6	2.0		[SC] Brown and gray brown, Clayey fine to coarse SAND, moist.			PID Reading = 0 from a depth of 0 to 5.6 feet.	
			[SC] Brown and gray brown, Clayey fine to coarse SAND, moist.			FILL	
			[SC] Orange-brown mottled with gray, Clayey fine to coarse SAND, moist.			Environmental Sample collected from a depth of 2 to 3.3 feet	
			[SC] Orange-brown mottled with gray, Clayey fine to coarse SAND, moist.				
1	5.6		No Recovery				
-1.4	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,112.0 E 12,108,661.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP06				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 5.1				17. ELEVATION TOP OF HOLE +6.5		±	
8. DEPTH DRILLED INTO ROCK Not Encountered				18. TOTAL CORE RECOVERY FOR BORING		%	
9. TOTAL DEPTH OF HOLE 5.1				19. GEOLOGIST Matthew Thornton			
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.			PID Reading = 0 from a depth of 0 to 5.1 feet.	
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.				
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.			Environmental Sample collected from a depth of 2 to 4 feet	
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.				
			[SC] Brown, light brown and orange-brown, fine to medium SAND, with some clay, moist.				
1.4	5.1		No Recovery			FILL	
-1.5	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,117.1 E 12,108,500.6				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP07				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 8.0				17. ELEVATION TOP OF HOLE +6.1		±	
8. DEPTH DRILLED INTO ROCK Not Encountered				18. TOTAL CORE RECOVERY FOR BORING		%	
9. TOTAL DEPTH OF HOLE 8.0				19. GEOLOGIST Matthew Thornton			
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown to light brown, Clayey fine to coarse SAND, with trace gravel, moist.			PID Reading = 0 from a depth of 0 to 8 feet.	
						Environmental Sample collected from a depth of 2.5 to 4 feet	
1.1	5.0		[SC] Orange-brown mottled with gray, Clayey fine to medium SAND, wet.			FILL	
-1.9	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,061.7 E 12,108,415.4				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP08				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 8.0				17. ELEVATION TOP OF HOLE +6.9 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 8.0							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown and gray, fine to coarse SAND, with some clay, moist.			PID Reading = 0 from a depth of 0 to 8 feet.	
						Environmental Sample collected from a depth of 2 to 4 feet	
						FILL	
1.4	5.5		[SC] Orange-brown mottled with gray, fine to medium SAND, with some clay, wet.			STRATUM 1	
-1.1	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.				

DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,559,054.8 E 12,108,349.8				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP09				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER NA		16. DATE HOLE STARTED 1/20/2010 COMPLETED 1/20/2010	
7. THICKNESS OF OVERBURDEN 6.0				17. ELEVATION TOP OF HOLE +7.2 ±		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK Not Encountered				19. GEOLOGIST Matthew Thornton			
9. TOTAL DEPTH OF HOLE 6.0							
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
			[SC] Brown, Clayey fien to coarse SAND, with trace gravel, moist.			PID Reading = 0 from a depth of 0 to 6 feet.	
3.2	4.0		[SC] Orange-brown mottled with gray, fine to coarse SAND, with some clay and trace gravel, moist.			Environmental Sample collected from a depth of 2 to 4 feet	
1.2	6.0		Geoprobe terminated at a depth of 6 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	
						Refusal at a depth of 6 due to an obstruction	



DRILLING LOG		DIVISION NAO		INSTALLATION Langley AFB		SHEET 1 OF 1 SHEETS	
1. PROJECT F-22 Hangar Expansion, Langley AFB				10. SIZE AND TYPE OF BIT 1.5" ID Geoprobe			
2. LOCATION (Coordinates or Station) Hampton, VA N 3,558,986.4 E 12,108,514.7				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88			
3. DRILLING AGENCY ConeTec				12. MANUFACTURER'S DESIGNATION OF DRILL Multi-Truck			
4. HOLE NO. (As shown on drawing title and file number) 10GP10				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED 2 UNDISTURBED 0	
5. NAME OF DRILLER Richard Haller				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.				15. ELEVATION GROUND WATER		NA	
7. THICKNESS OF OVERBURDEN 5.6				16. DATE HOLE		STARTED 1/20/2010 COMPLETED 1/20/2010	
8. DEPTH DRILLED INTO ROCK Not Encountered				17. ELEVATION TOP OF HOLE		+6.3 ±	
9. TOTAL DEPTH OF HOLE 5.6				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. GEOLOGIST		Matthew Thornton	
ELEVATION (feet) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	SAMPLE DEPTH (feet) e	SAMPLE BLOWS f	REMARKS (Drilling time, water loss, dept weathering, etc., if significant) g	
4.3	2.0		[SM] Gray, fine to medium SAND, with some clay, moist.			PID Reading = 0 from a depth of 0 to 5.6 feet.	
			[SC] Orange-brown mottled with gray, Clayey fine to coarse SAND, with trace gravel, moist.			FILL	
0.7	5.6		No Recovery			Environmental Sample collected from a depth of 2 to 4 feet	
-1.7	8.0		Geoprobe terminated at a depth of 8 feet. Geoprobe hole was backfilled with pea gravel upon completion.			STRATUM 1	



### **APPENDIX III**

#### Laboratory Data

Analytical Method	Compound	EPA SL for Industrial Soil	Units	10GP01 1 to 4ft		10GP02 1.3 to 3.5ft		10GP03 2.1 to 3.4ft		10GP04 2 to 4ft		10GP05 2 to 3.3ft	
				Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
6020	Arsenic	1.6	mg/Kg	15		2.4		8.2		6.2		13	
	Beryllium	2000	mg/Kg	0.58		0.24		0.31		0.25		0.42	
	Cadmium	810	mg/Kg	ND		ND		ND		ND		ND	
	Chromium	1400	mg/Kg	35		12		32		30		29	
	Copper	41000	mg/Kg	3.1	Q	6.6	Q	3.5	Q	2.8	Q	3.1	Q
	Lead	800	mg/Kg	12		10		12		11		9.3	
	Nickel	20000	mg/Kg	8.8	Q	4.3	Q	8.1	Q	6	Q	5.4	Q
	Thallium	66	mg/Kg	0.16	J	0.12	J	0.13	J	0.13	J	0.13	J
	Zinc	310000	mg/Kg	18		13		13		12		20	
8015B	Diesel Range Organics	NA	mg/Kg	150	M	14	M	9.3	M	6.7	M	7.7	M
	Gasoline Range Organics (GRO)	NA	mg/Kg	ND		ND		ND		ND		0.072	J
9023	Halogens, Extractable Organic	NA	mg/Kg	16	J	13	J	ND		ND		ND	

Analytical Method	Compound	EPA SL for Industrial Soil	Units	10GP06 2 to 4ft		10GP07 2.5 to 4ft		10GP08 2 to 4ft		10GP09 2 to 4ft		10GP10 2 to 4ft	
				Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
6020	Arsenic	1.6	mg/Kg	2.6		21		5.2		11		33	
	Beryllium	2000	mg/Kg	0.21		0.64		0.53		0.4		0.77	
	Cadmium	810	mg/Kg	ND		ND		ND		ND		0.075	J Q
	Chromium	1400	mg/Kg	14		32		11		17		40	
	Copper	41000	mg/Kg	1.7	Q	2.7	Q	1.8	Q	4.3	Q	4.4	Q
	Lead	800	mg/Kg	7.1		11		8.3		10		16	
	Nickel	20000	mg/Kg	3.7	Q	7.6	Q	5.7	Q	5.2	Q	9.5	Q
	Thallium	66	mg/Kg	0.094	J	0.12	J	0.11	J	0.11	J	0.14	J
	Zinc	310000	mg/Kg	8.5		14		29		17		27	
8015B	Diesel Range Organics	NA	mg/Kg	4.6	M	5.1	M	190	M	78	M	19	M
	Gasoline Range Organics (GRO)	NA	mg/Kg	ND		0.28	J	ND		ND		ND	
9023	Halogens, Extractable Organic	NA	mg/Kg	ND		ND		ND		ND		ND	

## Notes:

Highlighted Values Exceed EPA Established Screening Levels for Industrial Soil

ND - Not Detected

Q - One or more quality control criteria failed.

J - Estimated: The analyte was positively identified; the quantitation is an estimation

M - Manual integrated compound.



## ANALYTICAL REPORT

Job Number: 680-54422-1

SDG Number: 680-54422-1

Job Description: LAFB - F22 Hanger Addition Soils 1/21/10

For:  
S&ME, Inc.  
8211 Hermitage Road  
Richmond, VA 23228  
Attention: David Sayre

Approved for release.  
Lidya Gulizia  
Project Manager I  
2/18/2010 12:01 PM

---

Lidya Gulizia  
Project Manager I  
lidya.gulizia@testamericainc.com  
02/18/2010

cc: Ms. Tara Mason

The test results in this report meet NELAP requirements for parameters for which accreditation is required or available. Any exceptions to the NELAP requirements are noted. Results pertain only to samples listed in this report. This report may not be reproduced, except in full, without the written approval of the laboratory. Questions should be directed to the person who signed this report.

Savannah Certifications and ID #s: A2LA: 0399.01; AL: 41450; ARDEQ: 88-0692; ARDOH; AZ: AZ0741; CA: 03217CA; CO; CT: PH0161; DE; FL: E87052; GA: 803; Guam; HI; IL: 200022; IN; IA: 353; KS: E-10322; KY EPPC: 90084; KY UST; LA DEQ: 30690; LA DHH: LA080008; ME: 2008022; MD: 250; MA: M-GA006; MI: 9925; MS; NFESC: 249; NV: GA00006; NJ: GA769; NM; NY: 10842; NC DWQ: 269; NC DHHS: 13701; PA: 68-00474; PR: GA00006; RI: LAO00244; SC: 98001001; TN: TN0296; TX: T104704185; USEPA: GA00006; VT: VT-87052; VA: 00302; WA; WV DEP: 094; WV DHHR: 9950 C; WI DNR: 999819810; WY/EPAR8: 8TMS-Q

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Tel (912) 354-7858 Fax (912) 352-0165 [www.testamericainc.com](http://www.testamericainc.com)



**Job Narrative**  
**680-54422-1 / SDG 680-54422-1****Receipt**

All samples were received in good condition within temperature requirements.

**GC/MS VOA**

No analytical or quality issues were noted.

**GC VOA**

Method(s) 8015B: Internal standard (ISTD) response for the following sample was outside control limits: 10GP07 2.5 to 4ft (680-54422-7). The sample was re-analyzed with concurring results. The original set of data has been reported.

No other analytical or quality issues were noted.

**GC Semi VOA**

No analytical or quality issues were noted.

**Metals**

Method(s) 6020: The instrument blank for analytical batch 159821 contained nickel greater than one-half the reporting limit (RL). The data have been qualified and reported.

Method(s) 6020: The ICSA for batch 160423 exceeded the acceptance limits for elements: Cadmium, Copper and Nickel.

Method(s) 6020: Due to the high concentration of copper, lead, and zinc, the matrix spike / matrix spike duplicate (MS/MSD) for batch 680-159821 could not be evaluated for accuracy and precision. The associated laboratory control sample (LCS) met acceptance criteria.

Method(s) 6020: The matrix spike / matrix spike duplicate (MS/MSD) recoveries for batch 680-159821 were outside control limits for chromium, mercury, arsenic, and nickel. The associated laboratory control sample (LCS) recovery met acceptance criteria.

Method(s) 6020: The matrix spike / matrix spike duplicate (MS/MSD) precision for batch 680-159821 was outside control limits for mercury. Non-homogeneity of the sample matrix is suspected.

Method(s) 6020: The serial dilution performed for the following sample was outside control limits for lead: (680-54612-2 SD)

Method(s) 6020: The matrix spike / matrix spike duplicate (MS/MSD) recoveries for batch 680-159984 were outside control limits for chromium, copper, lead, and zinc. The associated laboratory control sample (LCS) recovery met acceptance criteria.

Method(s) 6020: The matrix spike / matrix spike duplicate (MS/MSD) precision for batch 680-159984 was outside control limits for copper. Non-homogeneity of the sample matrix is suspected.

No other analytical or quality issues were noted.

**General Chemistry**

No analytical or quality issues were noted.

**Organic Prep**

No analytical or quality issues were noted.

**VOA Prep**

The Encore vials submitted for the following sample(s) contained significantly greater than 5 grams: All of the client sample vials have high weights except for one of two deionized water-preserved vials for lab ID 680-54422-1 (vial F).

No other analytical or quality issues were noted.

**Comments**

No additional comments.

**METHOD SUMMARY**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

Description	Lab Location	Method	Preparation Method
<b>Matrix: Solid</b>			
Volatile Organic Compounds (GC/MS)	TAL SAV	SW846 8260B	
Purge and Trap	TAL SAV		SW846 5030A
Gasoline Range Organics - (GC)	TAL SAV	SW846 8015B	
Purge and Trap	TAL SAV		SW846 5030A
Diesel Range Organics (DRO) (GC)	TAL SAV	SW846 8015B	
Ultrasonic Extraction	TAL SAV		SW846 3550B
Metals (ICP/MS)	TAL SAV	SW846 6020	
Preparation, Metals	TAL SAV		SW846 3050B
Organic Halides, Extractable (EOX)	TAL SAV	SW846 9023	

**Lab References:**

TAL SAV = TestAmerica Savannah

**Method References:**

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Method	Analyst	Analyst ID
SW846 8260B	Sokolin, Eleina	ES
SW846 8015B	Moncrief, Amy	AEM
SW846 8015B	Smith, Crystal	CAS
SW846 6020	Boyuk, Brian	BB
SW846 9023	Nelson, Christopher	CN

**SAMPLE SUMMARY**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
680-54422-1	10GP01 1 to 4ft	Solid	01/20/2010 1114	01/22/2010 0909
680-54422-2	10GP02 1.3 to 3.5ft	Solid	01/20/2010 1159	01/22/2010 0909
680-54422-3	10GP03 2.1 to 3.4ft	Solid	01/20/2010 1224	01/22/2010 0909
680-54422-4	10GP04 2 to 4ft	Solid	01/20/2010 1254	01/22/2010 0909
680-54422-5	10GP05 2 to 3.3ft	Solid	01/20/2010 1321	01/22/2010 0909
680-54422-6	10GP06 2 to 4ft	Solid	01/20/2010 1340	01/22/2010 0909
680-54422-7	10GP07 2.5 to 4ft	Solid	01/20/2010 1423	01/22/2010 0909
680-54422-8	10GP08 2 to 4ft	Solid	01/20/2010 1440	01/22/2010 0909
680-54422-9	10GP09 2 to 4ft	Solid	01/20/2010 1500	01/22/2010 0909
680-54422-10	10GP10 2 to 4ft	Solid	01/20/2010 1527	01/22/2010 0909



# **SAMPLE RESULTS**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP01 1 to 4ft

Lab Sample ID: 680-54422-1

Date Sampled: 01/20/2010 1114

Client Matrix: Solid

% Moisture: 10.5

Date Received: 01/22/2010 0909

**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159288	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0183.d
Dilution:	1.0		Initial Weight/Volume:	5.08 g
Date Analyzed:	01/27/2010 1508		Final Weight/Volume:	5 mL
Date Prepared:	01/27/2010 1508			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.1	U	0.80	5.5
Ethylbenzene		1.4	U	1.4	5.5
Toluene		1.1	U	0.92	5.5
Xylenes, Total		1.2	U	1.2	11

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	92		65 - 124
Dibromofluoromethane	91		65 - 124
Toluene-d8 (Surr)	101		65 - 132

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP02 1.3 to 3.5ft

Lab Sample ID: 680-54422-2

Date Sampled: 01/20/2010 1159

Client Matrix: Solid

% Moisture: 13.0

Date Received: 01/22/2010 0909

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**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159288	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0184.d
Dilution:	1.0		Initial Weight/Volume:	5.57 g
Date Analyzed:	01/27/2010 1531		Final Weight/Volume:	5 mL
Date Prepared:	01/27/2010 1531			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.0	U	0.75	5.2
Ethylbenzene		1.3	U	1.3	5.2
Toluene		1.0	U	0.87	5.2
Xylenes, Total		1.1	U	1.1	10

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	93		65 - 124
Dibromofluoromethane	92		65 - 124
Toluene-d8 (Surr)	103		65 - 132

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP03 2.1 to 3.4ft

Lab Sample ID: 680-54422-3

Date Sampled: 01/20/2010 1224

Client Matrix: Solid

% Moisture: 14.1

Date Received: 01/22/2010 0909

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**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159288	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0185.d
Dilution:	1.0		Initial Weight/Volume:	5.69 g
Date Analyzed:	01/27/2010 1554		Final Weight/Volume:	5 mL
Date Prepared:	01/27/2010 1554			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.0	U	0.75	5.1
Ethylbenzene		1.3	U	1.3	5.1
Toluene		1.0	U	0.86	5.1
Xylenes, Total		1.1	U	1.1	10

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	91		65 - 124
Dibromofluoromethane	90		65 - 124
Toluene-d8 (Surr)	100		65 - 132

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID: 10GP04 2 to 4ft**

Lab Sample ID: 680-54422-4

Date Sampled: 01/20/2010 1254

Client Matrix: Solid

% Moisture: 17.3

Date Received: 01/22/2010 0909

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**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159288	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0186.d
Dilution:	1.0		Initial Weight/Volume:	5.43 g
Date Analyzed:	01/27/2010 1617		Final Weight/Volume:	5 mL
Date Prepared:	01/27/2010 1617			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.1	U	0.81	5.6
Ethylbenzene		1.4	U	1.4	5.6
Toluene		1.1	U	0.94	5.6
Xylenes, Total		1.2	U	1.2	11

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	91		65 - 124
Dibromofluoromethane	95		65 - 124
Toluene-d8 (Surr)	100		65 - 132

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID: 10GP05 2 to 3.3ft**

Lab Sample ID: 680-54422-5

Date Sampled: 01/20/2010 1321

Client Matrix: Solid

% Moisture: 13.1

Date Received: 01/22/2010 0909

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**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159480	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0194.d
Dilution:	1.0		Initial Weight/Volume:	5.15 g
Date Analyzed:	01/28/2010 1211		Final Weight/Volume:	5 mL
Date Prepared:	01/28/2010 1211			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.1	U	0.82	5.6
Ethylbenzene		1.5	U	1.5	5.6
Toluene		1.1	U	0.94	5.6
Xylenes, Total		1.2	U	1.2	11

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	96		65 - 124
Dibromofluoromethane	89		65 - 124
Toluene-d8 (Surr)	99		65 - 132

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID: 10GP06 2 to 4ft**

Lab Sample ID: 680-54422-6

Date Sampled: 01/20/2010 1340

Client Matrix: Solid

% Moisture: 13.2

Date Received: 01/22/2010 0909

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**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159288	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0188.d
Dilution:	1.0		Initial Weight/Volume:	4.70 g
Date Analyzed:	01/27/2010 1702		Final Weight/Volume:	5 mL
Date Prepared:	01/27/2010 1702			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.2	U	0.90	6.1
Ethylbenzene		1.6	U	1.6	6.1
Toluene		1.2	U	1.0	6.1
Xylenes, Total		1.3	U	1.3	12

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	92		65 - 124
Dibromofluoromethane	93		65 - 124
Toluene-d8 (Surr)	103		65 - 132

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP07 2.5 to 4ft

Lab Sample ID: 680-54422-7

Date Sampled: 01/20/2010 1423

Client Matrix: Solid

% Moisture: 17.8

Date Received: 01/22/2010 0909

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**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159288	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0189.d
Dilution:	1.0		Initial Weight/Volume:	5.55 g
Date Analyzed:	01/27/2010 1725		Final Weight/Volume:	5 mL
Date Prepared:	01/27/2010 1725			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.1	U	0.80	5.5
Ethylbenzene		1.4	U	1.4	5.5
Toluene		1.1	U	0.92	5.5
Xylenes, Total		1.2	U	1.2	11

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	95		65 - 124
Dibromofluoromethane	89		65 - 124
Toluene-d8 (Surr)	101		65 - 132



Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP08 2 to 4ft

Lab Sample ID: 680-54422-8

Date Sampled: 01/20/2010 1440

Client Matrix: Solid

% Moisture: 8.6

Date Received: 01/22/2010 0909

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**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159288	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0190.d
Dilution:	1.0		Initial Weight/Volume:	5.03 g
Date Analyzed:	01/27/2010 1747		Final Weight/Volume:	5 mL
Date Prepared:	01/27/2010 1747			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.1	U	0.79	5.4
Ethylbenzene		1.4	U	1.4	5.4
Toluene		1.1	U	0.91	5.4
Xylenes, Total		1.2	U	1.2	11

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	87		65 - 124
Dibromofluoromethane	89		65 - 124
Toluene-d8 (Surr)	101		65 - 132

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP09 2 to 4ft

Lab Sample ID: 680-54422-9

Date Sampled: 01/20/2010 1500

Client Matrix: Solid

% Moisture: 12.2

Date Received: 01/22/2010 0909

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**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159288	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0191.d
Dilution:	1.0		Initial Weight/Volume:	5.02 g
Date Analyzed:	01/27/2010 1810		Final Weight/Volume:	5 mL
Date Prepared:	01/27/2010 1810			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.1	U	0.83	5.7
Ethylbenzene		1.5	U	1.5	5.7
Toluene		1.1	U	0.95	5.7
Xylenes, Total		1.2	U	1.2	11

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	89		65 - 124
Dibromofluoromethane	92		65 - 124
Toluene-d8 (Surr)	100		65 - 132

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP10 2 to 4ft

Lab Sample ID: 680-54422-10

Date Sampled: 01/20/2010 1527

Client Matrix: Solid

% Moisture: 14.7

Date Received: 01/22/2010 0909

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**8260B Volatile Organic Compounds (GC/MS)**

Method:	8260B	Analysis Batch: 680-159288	Instrument ID:	MSM
Preparation:	5030A		Lab File ID:	m0192.d
Dilution:	1.0		Initial Weight/Volume:	5.17 g
Date Analyzed:	01/27/2010 1833		Final Weight/Volume:	5 mL
Date Prepared:	01/27/2010 1833			

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	DL	LOQ
Benzene		1.1	U	0.83	5.7
Ethylbenzene		1.5	U	1.5	5.7
Toluene		1.1	U	0.95	5.7
Xylenes, Total		1.2	U	1.2	11

Surrogate	%Rec	Qualifier	Acceptance Limits
4-Bromofluorobenzene	92		65 - 124
Dibromofluoromethane	91		65 - 124
Toluene-d8 (Surr)	101		65 - 132

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP01 1 to 4ft

Lab Sample ID: 680-54422-1

Date Sampled: 01/20/2010 1114

Client Matrix: Solid

% Moisture: 10.5

Date Received: 01/22/2010 0909

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**8015B Gasoline Range Organics - (GC)**

Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1
Preparation:	5030A		Initial Weight/Volume:	5 g
Dilution:	1.0		Final Weight/Volume:	5 mL
Date Analyzed:	01/29/2010 1039		Injection Volume:	
Date Prepared:	01/29/2010 1039		Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.0559	U	0.021	0.28

Surrogate	%Rec	Qualifier	Acceptance Limits
a,a,a-Trifluorotoluene	93		53 - 121

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP02 1.3 to 3.5ft

Lab Sample ID: 680-54422-2  
Client Matrix: Solid

% Moisture: 13.0

Date Sampled: 01/20/2010 1159  
Date Received: 01/22/2010 0909

8015B Gasoline Range Organics - (GC)					
Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1	
Preparation:	5030A		Initial Weight/Volume:	5 g	
Dilution:	1.0		Final Weight/Volume:	5 mL	
Date Analyzed:	01/29/2010 1104		Injection Volume:		
Date Prepared:	01/29/2010 1104		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.0575	U	0.022	0.29
Surrogate		%Rec	Qualifier	Acceptance Limits	
a,a,a-Trifluorotoluene		90		53 - 121	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP03 2.1 to 3.4ft

Lab Sample ID: 680-54422-3  
Client Matrix: Solid

% Moisture: 14.1

Date Sampled: 01/20/2010 1224  
Date Received: 01/22/2010 0909

8015B Gasoline Range Organics - (GC)					
Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1	
Preparation:	5030A		Initial Weight/Volume:	5 g	
Dilution:	1.0		Final Weight/Volume:	5 mL	
Date Analyzed:	01/29/2010 1128		Injection Volume:		
Date Prepared:	01/29/2010 1128		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.0582	U	0.022	0.29
Surrogate		%Rec	Qualifier	Acceptance Limits	
a,a,a-Trifluorotoluene		94		53 - 121	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP04 2 to 4ft

Lab Sample ID: 680-54422-4  
Client Matrix: Solid

% Moisture: 17.3

Date Sampled: 01/20/2010 1254  
Date Received: 01/22/2010 0909

8015B Gasoline Range Organics - (GC)					
Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1	
Preparation:	5030A		Initial Weight/Volume:	5 g	
Dilution:	1.0		Final Weight/Volume:	5 mL	
Date Analyzed:	01/29/2010 1153		Injection Volume:		
Date Prepared:	01/29/2010 1153		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.0605	U	0.023	0.30
Surrogate		%Rec	Qualifier	Acceptance Limits	
a,a,a-Trifluorotoluene		91		53 - 121	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP05 2 to 3.3ft

Lab Sample ID: 680-54422-5  
Client Matrix: Solid

% Moisture: 13.1

Date Sampled: 01/20/2010 1321  
Date Received: 01/22/2010 0909

8015B Gasoline Range Organics - (GC)					
Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1	
Preparation:	5030A		Initial Weight/Volume:	5 g	
Dilution:	1.0		Final Weight/Volume:	5 mL	
Date Analyzed:	01/29/2010 1218		Injection Volume:		
Date Prepared:	01/29/2010 1218		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.072	J	0.022	0.29
Surrogate		%Rec	Qualifier	Acceptance Limits	
a,a,a-Trifluorotoluene		92		53 - 121	



Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP06 2 to 4ft

Lab Sample ID: 680-54422-6  
Client Matrix: Solid

% Moisture: 13.2

Date Sampled: 01/20/2010 1340  
Date Received: 01/22/2010 0909

8015B Gasoline Range Organics - (GC)					
Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1	
Preparation:	5030A		Initial Weight/Volume:	5 g	
Dilution:	1.0		Final Weight/Volume:	5 mL	
Date Analyzed:	01/29/2010 1242		Injection Volume:		
Date Prepared:	01/29/2010 1242		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.0576	U	0.022	0.29
Surrogate		%Rec	Qualifier	Acceptance Limits	
a,a,a-Trifluorotoluene		91		53 - 121	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP07 2.5 to 4ft

Lab Sample ID: 680-54422-7  
Client Matrix: Solid

% Moisture: 17.8

Date Sampled: 01/20/2010 1423  
Date Received: 01/22/2010 0909

8015B Gasoline Range Organics - (GC)					
Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1	
Preparation:	5030A		Initial Weight/Volume:	5 g	
Dilution:	1.0		Final Weight/Volume:	5 mL	
Date Analyzed:	01/29/2010 1304		Injection Volume:		
Date Prepared:	01/29/2010 1304		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.28	J	0.023	0.30
Surrogate		%Rec	Qualifier	Acceptance Limits	
a,a,a-Trifluorotoluene		90		53 - 121	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP08 2 to 4ft

Lab Sample ID: 680-54422-8  
Client Matrix: Solid

% Moisture: 8.6

Date Sampled: 01/20/2010 1440  
Date Received: 01/22/2010 0909

8015B Gasoline Range Organics - (GC)					
Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1	
Preparation:	5030A		Initial Weight/Volume:	5 g	
Dilution:	1.0		Final Weight/Volume:	5 mL	
Date Analyzed:	01/29/2010 1329		Injection Volume:		
Date Prepared:	01/29/2010 1329		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.0547	U	0.021	0.27
Surrogate		%Rec	Qualifier	Acceptance Limits	
a,a,a-Trifluorotoluene		114		53 - 121	

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP09 2 to 4ft

Lab Sample ID: 680-54422-9

Date Sampled: 01/20/2010 1500

Client Matrix: Solid

% Moisture: 12.2

Date Received: 01/22/2010 0909

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**8015B Gasoline Range Organics - (GC)**

Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1
Preparation:	5030A		Initial Weight/Volume:	5 g
Dilution:	1.0		Final Weight/Volume:	5 mL
Date Analyzed:	01/29/2010 1354		Injection Volume:	
Date Prepared:	01/29/2010 1354		Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.0570	U	0.022	0.28

Surrogate	%Rec	Qualifier	Acceptance Limits
a,a,a-Trifluorotoluene	97		53 - 121

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP10 2 to 4ft

Lab Sample ID: 680-54422-10  
Client Matrix: Solid

% Moisture: 14.7

Date Sampled: 01/20/2010 1527  
Date Received: 01/22/2010 0909

8015B Gasoline Range Organics - (GC)					
Method:	8015B	Analysis Batch: 680-159618	Instrument ID:	VGWFID1	
Preparation:	5030A		Initial Weight/Volume:	5 g	
Dilution:	1.0		Final Weight/Volume:	5 mL	
Date Analyzed:	01/29/2010 1453		Injection Volume:		
Date Prepared:	01/29/2010 1453		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10		0.0586	U	0.022	0.29
Surrogate		%Rec	Qualifier	Acceptance Limits	
a,a,a-Trifluorotoluene		98		53 - 121	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP01 1 to 4ft

Lab Sample ID: 680-54422-1  
Client Matrix: Solid

% Moisture: 10.5

Date Sampled: 01/20/2010 1114  
Date Received: 01/22/2010 0909

8015B Diesel Range Organics (DRO) (GC)					
Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ	
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.22 g	
Dilution:	1.0		Final Weight/Volume:	1 mL	
Date Analyzed:	01/28/2010 0955		Injection Volume:	2 uL	
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		150	M	2.3	3.7
Surrogate		%Rec	Qualifier	Acceptance Limits	
o-Terphenyl		106	M	39 - 140	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP02 1.3 to 3.5ft

Lab Sample ID: 680-54422-2  
Client Matrix: Solid

% Moisture: 13.0

Date Sampled: 01/20/2010 1159  
Date Received: 01/22/2010 0909

8015B Diesel Range Organics (DRO) (GC)					
Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ	
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.01 g	
Dilution:	1.0		Final Weight/Volume:	1 mL	
Date Analyzed:	01/28/2010 1017		Injection Volume:	2 uL	
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		14	M	2.4	3.8
Surrogate		%Rec	Qualifier	Acceptance Limits	
o-Terphenyl		106	M	39 - 140	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP03 2.1 to 3.4ft

Lab Sample ID: 680-54422-3  
Client Matrix: Solid

% Moisture: 14.1

Date Sampled: 01/20/2010 1224  
Date Received: 01/22/2010 0909

8015B Diesel Range Organics (DRO) (GC)					
Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ	
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.22 g	
Dilution:	1.0		Final Weight/Volume:	1 mL	
Date Analyzed:	01/28/2010 1028		Injection Volume:	2 uL	
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		9.3	M	2.4	3.8
Surrogate		%Rec	Qualifier	Acceptance Limits	
o-Terphenyl		100	M	39 - 140	



Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP04 2 to 4ft

Lab Sample ID: 680-54422-4

Date Sampled: 01/20/2010 1254

Client Matrix: Solid

% Moisture: 17.3

Date Received: 01/22/2010 0909

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**8015B Diesel Range Organics (DRO) (GC)**

Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.15 g
Dilution:	1.0		Final Weight/Volume:	1 mL
Date Analyzed:	01/28/2010 1039		Injection Volume:	2 uL
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		6.7	M	2.5	4.0

Surrogate	%Rec	Qualifier	Acceptance Limits
o-Terphenyl	99	M	39 - 140

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP05 2 to 3.3ft

Lab Sample ID: 680-54422-5

Date Sampled: 01/20/2010 1321

Client Matrix: Solid

% Moisture: 13.1

Date Received: 01/22/2010 0909

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**8015B Diesel Range Organics (DRO) (GC)**

Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.10 g
Dilution:	1.0		Final Weight/Volume:	1 mL
Date Analyzed:	01/28/2010 1049		Injection Volume:	2 uL
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		7.7	M	2.4	3.8

Surrogate	%Rec	Qualifier	Acceptance Limits
o-Terphenyl	127	M	39 - 140

Client: S&ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

Client Sample ID: 10GP06 2 to 4ft

Lab Sample ID: 680-54422-6

Date Sampled: 01/20/2010 1340

Client Matrix: Solid

% Moisture: 13.2

Date Received: 01/22/2010 0909

8015B Diesel Range Organics (DRO) (GC)					
Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ	
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.09 g	
Dilution:	1.0		Final Weight/Volume:	1 mL	
Date Analyzed:	01/28/2010 1100		Injection Volume:	2 uL	
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		4.6	M	2.4	3.8
Surrogate		%Rec	Qualifier	Acceptance Limits	
o-Terphenyl		95	M	39 - 140	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP07 2.5 to 4ft

Lab Sample ID: 680-54422-7  
Client Matrix: Solid

% Moisture: 17.8

Date Sampled: 01/20/2010 1423  
Date Received: 01/22/2010 0909

8015B Diesel Range Organics (DRO) (GC)					
Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ	
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.27 g	
Dilution:	1.0		Final Weight/Volume:	1 mL	
Date Analyzed:	01/28/2010 1111		Injection Volume:	2 uL	
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		5.1	M	2.5	4.0
Surrogate		%Rec	Qualifier	Acceptance Limits	
o-Terphenyl		132	M	39 - 140	

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP08 2 to 4ft

Lab Sample ID: 680-54422-8

Date Sampled: 01/20/2010 1440

Client Matrix: Solid

% Moisture: 8.6

Date Received: 01/22/2010 0909

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**8015B Diesel Range Organics (DRO) (GC)**

Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.03 g
Dilution:	1.0		Final Weight/Volume:	1 mL
Date Analyzed:	01/28/2010 1122		Injection Volume:	2 uL
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		190	M	2.3	3.6

Surrogate	%Rec	Qualifier	Acceptance Limits
o-Terphenyl	122	M	39 - 140

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP09 2 to 4ft

Lab Sample ID: 680-54422-9  
Client Matrix: Solid

% Moisture: 12.2

Date Sampled: 01/20/2010 1500  
Date Received: 01/22/2010 0909

8015B Diesel Range Organics (DRO) (GC)					
Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ	
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.04 g	
Dilution:	1.0		Final Weight/Volume:	1 mL	
Date Analyzed:	01/28/2010 1143		Injection Volume:	2 uL	
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		78	M	2.4	3.8
Surrogate		%Rec	Qualifier	Acceptance Limits	
o-Terphenyl		115	M	39 - 140	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Client Sample ID: 10GP10 2 to 4ft

Lab Sample ID: 680-54422-10

Client Matrix: Solid

% Moisture: 14.7

Date Sampled: 01/20/2010 1527

Date Received: 01/22/2010 0909

8015B Diesel Range Organics (DRO) (GC)					
Method:	8015B	Analysis Batch: 680-159481	Instrument ID:	SGQ	
Preparation:	3550B	Prep Batch: 680-159276	Initial Weight/Volume:	30.02 g	
Dilution:	1.0		Final Weight/Volume:	1 mL	
Date Analyzed:	01/28/2010 1154		Injection Volume:	2 uL	
Date Prepared:	01/27/2010 1300		Result Type:	PRIMARY	
Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Diesel Range Organics [C10-C28]		19	M	2.5	3.9
Surrogate		%Rec	Qualifier	Acceptance Limits	
o-Terphenyl		88	M	39 - 140	

**Analytical Data**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP01 1 to 4ft

Lab Sample ID: 680-54422-1

Date Sampled: 01/20/2010 1114

Client Matrix: Solid

% Moisture: 10.5

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method: 6020

Analysis Batch: 680-160423

Instrument ID: ICPMSB

Preparation: 3050B

Prep Batch: 680-159821

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1.04 g

Date Analyzed: 02/08/2010 2024

Final Weight/Volume: 1000 mL

Date Prepared: 02/03/2010 1011

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.1	U	1.1	2.1
Arsenic		15		0.21	0.54
Beryllium		0.58		0.054	0.11
Cadmium		0.0537	U Q	0.026	0.11
Chromium		35		0.54	1.1
Copper		3.1	Q	0.43	1.1
Lead		12		0.21	0.43
Mercury		0.0859	U	0.086	0.21
Nickel		8.8	Q	0.12	0.21
Selenium		0.54	U	0.54	1.1
Silver		0.11	U	0.11	0.21
Thallium		0.16	J	0.054	0.21
Zinc		18		1.2	4.3



Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID: 10GP02 1.3 to 3.5ft**

Lab Sample ID: 680-54422-2

Date Sampled: 01/20/2010 1159

Client Matrix: Solid

% Moisture: 13.0

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method:	6020	Analysis Batch: 680-160423	Instrument ID:	ICPMSB
Preparation:	3050B	Prep Batch: 680-159821	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	1.05 g
Date Analyzed:	02/08/2010 2031		Final Weight/Volume:	1000 mL
Date Prepared:	02/03/2010 1011			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.1	U	1.1	2.2
Arsenic		2.4		0.22	0.55
Beryllium		0.24		0.055	0.11
Cadmium		0.0547	U Q	0.026	0.11
Chromium		12		0.55	1.1
Copper		6.6	Q	0.44	1.1
Lead		10		0.22	0.44
Mercury		0.0876	U	0.088	0.22
Nickel		4.3	Q	0.12	0.22
Selenium		0.55	U	0.55	1.1
Silver		0.11	U	0.11	0.22
Thallium		0.12	J	0.055	0.22
Zinc		13		1.2	4.4

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP03 2.1 to 3.4ft

Lab Sample ID: 680-54422-3

Date Sampled: 01/20/2010 1224

Client Matrix: Solid

% Moisture: 14.1

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method: 6020

Analysis Batch: 680-160423

Instrument ID: ICPMSB

Preparation: 3050B

Prep Batch: 680-159821

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1.08 g

Date Analyzed: 02/08/2010 2038

Final Weight/Volume: 1000 mL

Date Prepared: 02/03/2010 1011

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.1	U	1.1	2.2
Arsenic		8.2		0.22	0.54
Beryllium		0.31		0.054	0.11
Cadmium		0.0539	U Q	0.026	0.11
Chromium		32		0.54	1.1
Copper		3.5	Q	0.43	1.1
Lead		12		0.22	0.43
Mercury		0.0862	U	0.086	0.22
Nickel		8.1	Q	0.12	0.22
Selenium		0.54	U	0.54	1.1
Silver		0.11	U	0.11	0.22
Thallium		0.13	J	0.054	0.22
Zinc		13		1.2	4.3

**Analytical Data**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP04 2 to 4ft

Lab Sample ID: 680-54422-4

Date Sampled: 01/20/2010 1254

Client Matrix: Solid

% Moisture: 17.3

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method: 6020

Analysis Batch: 680-160423

Instrument ID: ICPMSB

Preparation: 3050B

Prep Batch: 680-159821

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1.01 g

Date Analyzed: 02/08/2010 2045

Final Weight/Volume: 1000 mL

Date Prepared: 02/03/2010 1011

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.2	U	1.2	2.4
Arsenic		6.2		0.24	0.60
Beryllium		0.25		0.060	0.12
Cadmium		0.0599	U Q	0.029	0.12
Chromium		30		0.60	1.2
Copper		2.8	Q	0.48	1.2
Lead		11		0.24	0.48
Mercury		0.0958	U	0.096	0.24
Nickel		6.0	Q	0.13	0.24
Selenium		0.60	U	0.60	1.2
Silver		0.12	U	0.12	0.24
Thallium		0.13	J	0.060	0.24
Zinc		12		1.3	4.8

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP05 2 to 3.3ft

Lab Sample ID: 680-54422-5

Date Sampled: 01/20/2010 1321

Client Matrix: Solid

% Moisture: 13.1

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method:	6020	Analysis Batch: 680-160423	Instrument ID:	ICPMSB
Preparation:	3050B	Prep Batch: 680-159821	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	1.01 g
Date Analyzed:	02/08/2010 2052		Final Weight/Volume:	1000 mL
Date Prepared:	02/03/2010 1011			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.1	U	1.1	2.3
Arsenic		13		0.23	0.57
Beryllium		0.42		0.057	0.11
Cadmium		0.0570	U Q	0.027	0.11
Chromium		29		0.57	1.1
Copper		3.1	Q	0.46	1.1
Lead		9.3		0.23	0.46
Mercury		0.0912	U	0.091	0.23
Nickel		5.4	Q	0.13	0.23
Selenium		0.57	U	0.57	1.1
Silver		0.11	U	0.11	0.23
Thallium		0.13	J	0.057	0.23
Zinc		20		1.3	4.6

**Analytical Data**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP06 2 to 4ft

Lab Sample ID: 680-54422-6

Date Sampled: 01/20/2010 1340

Client Matrix: Solid

% Moisture: 13.2

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method: 6020

Analysis Batch: 680-160423

Instrument ID: ICPMSB

Preparation: 3050B

Prep Batch: 680-159821

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1.03 g

Date Analyzed: 02/08/2010 2114

Final Weight/Volume: 1000 mL

Date Prepared: 02/03/2010 1011

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.1	U	1.1	2.2
Arsenic		2.6		0.22	0.56
Beryllium		0.21		0.056	0.11
Cadmium		0.0560	U Q	0.027	0.11
Chromium		14		0.56	1.1
Copper		1.7	Q	0.45	1.1
Lead		7.1		0.22	0.45
Mercury		0.0895	U	0.090	0.22
Nickel		3.7	Q	0.12	0.22
Selenium		0.56	U	0.56	1.1
Silver		0.11	U	0.11	0.22
Thallium		0.094	J	0.056	0.22
Zinc		8.5		1.2	4.5

**Analytical Data**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID: 10GP07 2.5 to 4ft**

Lab Sample ID: 680-54422-7

Date Sampled: 01/20/2010 1423

Client Matrix: Solid

% Moisture: 17.8

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method: 6020

Analysis Batch: 680-160423

Instrument ID: ICPMSB

Preparation: 3050B

Prep Batch: 680-159984

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1.08 g

Date Analyzed: 02/08/2010 2149

Final Weight/Volume: 1000 mL

Date Prepared: 02/04/2010 1459

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.1	U	1.1	2.3
Arsenic		21		0.23	0.56
Beryllium		0.64		0.056	0.11
Cadmium		0.0563	U Q	0.027	0.11
Chromium		32		0.56	1.1
Copper		2.7	Q	0.45	1.1
Lead		11		0.23	0.45
Mercury		0.0901	U	0.090	0.23
Nickel		7.6	Q	0.12	0.23
Selenium		0.56	U	0.56	1.1
Silver		0.11	U	0.11	0.23
Thallium		0.12	J	0.056	0.23
Zinc		14		1.2	4.5

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID: 10GP08 2 to 4ft**

Lab Sample ID: 680-54422-8

Date Sampled: 01/20/2010 1440

Client Matrix: Solid

% Moisture: 8.6

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method:	6020	Analysis Batch: 680-160423	Instrument ID:	ICPMSB
Preparation:	3050B	Prep Batch: 680-159984	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	1.02 g
Date Analyzed:	02/08/2010 2156		Final Weight/Volume:	1000 mL
Date Prepared:	02/04/2010 1459			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.1	U	1.1	2.1
Arsenic		5.2		0.21	0.54
Beryllium		0.53		0.054	0.11
Cadmium		0.0536	U Q	0.026	0.11
Chromium		11		0.54	1.1
Copper		1.8	Q	0.43	1.1
Lead		8.3		0.21	0.43
Mercury		0.0858	U	0.086	0.21
Nickel		5.7	Q	0.12	0.21
Selenium		0.54	U	0.54	1.1
Silver		0.11	U	0.11	0.21
Thallium		0.11	J	0.054	0.21
Zinc		29		1.2	4.3

**Analytical Data**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID:** 10GP09 2 to 4ft

Lab Sample ID: 680-54422-9

Date Sampled: 01/20/2010 1500

Client Matrix: Solid

% Moisture: 12.2

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method: 6020

Analysis Batch: 680-160423

Instrument ID: ICPMSB

Preparation: 3050B

Prep Batch: 680-159984

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1.00 g

Date Analyzed: 02/08/2010 2203

Final Weight/Volume: 1000 mL

Date Prepared: 02/04/2010 1459

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.1	U	1.1	2.3
Arsenic		11		0.23	0.57
Beryllium		0.40		0.057	0.11
Cadmium		0.0570	U Q	0.027	0.11
Chromium		17		0.57	1.1
Copper		4.3	Q	0.46	1.1
Lead		10		0.23	0.46
Mercury		0.0912	U	0.091	0.23
Nickel		5.2	Q	0.13	0.23
Selenium		0.57	U	0.57	1.1
Silver		0.11	U	0.11	0.23
Thallium		0.11	J	0.057	0.23
Zinc		17		1.3	4.6



**Analytical Data**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Client Sample ID: 10GP10 2 to 4ft**

Lab Sample ID: 680-54422-10

Date Sampled: 01/20/2010 1527

Client Matrix: Solid

% Moisture: 14.7

Date Received: 01/22/2010 0909

**6020 Metals (ICP/MS)**

Method: 6020

Analysis Batch: 680-160423

Instrument ID: ICPMSB

Preparation: 3050B

Prep Batch: 680-159984

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1.05 g

Date Analyzed: 02/08/2010 2210

Final Weight/Volume: 1000 mL

Date Prepared: 02/04/2010 1459

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	DL	LOQ
Antimony		1.1	U	1.1	2.2
Arsenic		33		0.22	0.56
Beryllium		0.77		0.056	0.11
Cadmium		0.075	J Q	0.027	0.11
Chromium		40		0.56	1.1
Copper		4.4	Q	0.45	1.1
Lead		16		0.22	0.45
Mercury		0.0893	U	0.089	0.22
Nickel		9.5	Q	0.12	0.22
Selenium		0.56	U	0.56	1.1
Silver		0.11	U	0.11	0.22
Thallium		0.14	J	0.056	0.22
Zinc		27		1.2	4.5

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

**Client Sample ID:** 10GP01 1 to 4ft

**Lab Sample ID:** 680-54422-1

**Date Sampled:** 01/20/2010 1114

**Client Matrix:** Solid

**% Moisture:** 10.5

**Date Received:** 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	16	J	mg/Kg	11	22	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

**Client Sample ID:** 10GP02 1.3 to 3.5ft

**Lab Sample ID:** 680-54422-2

**Date Sampled:** 01/20/2010 1159

**Client Matrix:** Solid

**% Moisture:** 13.0

**Date Received:** 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	13	J	mg/Kg	11	23	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

**Client Sample ID:** 10GP03 2.1 to 3.4ft

**Lab Sample ID:** 680-54422-3

**Date Sampled:** 01/20/2010 1224

**Client Matrix:** Solid

**% Moisture:** 14.1

**Date Received:** 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	10	U	mg/Kg	12	23	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

**Client Sample ID:** 10GP04 2 to 4ft

**Lab Sample ID:** 680-54422-4

**Date Sampled:** 01/20/2010 1254

**Client Matrix:** Solid

**% Moisture:** 17.3

**Date Received:** 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	10	U	mg/Kg	12	24	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

**Client Sample ID:** 10GP05 2 to 3.3ft

**Lab Sample ID:** 680-54422-5

**Date Sampled:** 01/20/2010 1321

**Client Matrix:** Solid

**% Moisture:** 13.1

**Date Received:** 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	10	U	mg/Kg	12	23	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

**Client Sample ID:** 10GP06 2 to 4ft

**Lab Sample ID:** 680-54422-6

**Date Sampled:** 01/20/2010 1340

**Client Matrix:** Solid

**% Moisture:** 13.2

**Date Received:** 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	10	U	mg/Kg	12	23	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

Client Sample ID: 10GP07 2.5 to 4ft

Lab Sample ID: 680-54422-7

Date Sampled: 01/20/2010 1423

Client Matrix: Solid

% Moisture: 17.8

Date Received: 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	10	U	mg/Kg	12	24	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	



Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

**Client Sample ID:** 10GP08 2 to 4ft

**Lab Sample ID:** 680-54422-8

**Date Sampled:** 01/20/2010 1440

**Client Matrix:** Solid

**% Moisture:** 8.6

**Date Received:** 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	10	U	mg/Kg	11	22	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

**Client Sample ID:** 10GP09 2 to 4ft

**Lab Sample ID:** 680-54422-9

**Date Sampled:** 01/20/2010 1500

**Client Matrix:** Solid

**% Moisture:** 12.2

**Date Received:** 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	10	U	mg/Kg	11	23	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

**General Chemistry**

Client Sample ID: 10GP10 2 to 4ft

Lab Sample ID: 680-54422-10

Date Sampled: 01/20/2010 1527

Client Matrix: Solid

% Moisture: 14.7

Date Received: 01/22/2010 0909

Analyte	Result	Qual	Units	DL	LOQ	Dil	Method
Halogens, Extractable Organic	10	U	mg/Kg	12	23	1.0	9023
Analysis Batch: 680-160295		Date Analyzed: 02/09/2010 0800				DryWt Corrected: Y	

## DATA REPORTING QUALIFIERS

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

Lab Section	Qualifier	Description
GC/MS VOA		
	U	Undetected at the Limit of Detection.
GC VOA		
	J	Estimated: The analyte was positively identified; the quantitation is an estimation
	U	Undetected at the Limit of Detection.
GC Semi VOA		
	M	Manual integrated compound.
	U	Undetected at the Limit of Detection.
Metals		
	J	Estimated: The analyte was positively identified; the quantitation is an estimation
	Q	One or more quality control criteria failed.
	U	Undetected at the Limit of Detection.
General Chemistry		
	J	Estimated: The analyte was positively identified; the quantitation is an estimation
	U	Undetected at the Limit of Detection.

# QUALITY CONTROL RESULTS

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
<b>GC/MS VOA</b>					
<b>Analysis Batch:680-159288</b>					
LCS 680-159288/5	Lab Control Sample	T	Solid	8260B	
LCSD 680-159288/6	Lab Control Sample Duplicate	T	Solid	8260B	
MB 680-159288/7	Method Blank	T	Solid	8260B	
680-54422-1	10GP01 1 to 4ft	T	Solid	8260B	
680-54422-2	10GP02 1.3 to 3.5ft	T	Solid	8260B	
680-54422-3	10GP03 2.1 to 3.4ft	T	Solid	8260B	
680-54422-4	10GP04 2 to 4ft	T	Solid	8260B	
680-54422-6	10GP06 2 to 4ft	T	Solid	8260B	
680-54422-7	10GP07 2.5 to 4ft	T	Solid	8260B	
680-54422-8	10GP08 2 to 4ft	T	Solid	8260B	
680-54422-9	10GP09 2 to 4ft	T	Solid	8260B	
680-54422-10	10GP10 2 to 4ft	T	Solid	8260B	

<b>Analysis Batch:680-159480</b>					
LCS 680-159480/15	Lab Control Sample	T	Solid	8260B	
LCSD 680-159480/16	Lab Control Sample Duplicate	T	Solid	8260B	
MB 680-159480/17	Method Blank	T	Solid	8260B	
680-54422-5	10GP05 2 to 3.3ft	T	Solid	8260B	

Report Basis

T = Total

## GC VOA

<b>Analysis Batch:680-159618</b>					
LCS 680-159618/16	Lab Control Sample	T	Solid	8015B	
MB 680-159618/17	Method Blank	T	Solid	8015B	
680-54422-1	10GP01 1 to 4ft	T	Solid	8015B	
680-54422-2	10GP02 1.3 to 3.5ft	T	Solid	8015B	
680-54422-2MS	Matrix Spike	T	Solid	8015B	
680-54422-2MSD	Matrix Spike Duplicate	T	Solid	8015B	
680-54422-3	10GP03 2.1 to 3.4ft	T	Solid	8015B	
680-54422-4	10GP04 2 to 4ft	T	Solid	8015B	
680-54422-5	10GP05 2 to 3.3ft	T	Solid	8015B	
680-54422-6	10GP06 2 to 4ft	T	Solid	8015B	
680-54422-7	10GP07 2.5 to 4ft	T	Solid	8015B	
680-54422-8	10GP08 2 to 4ft	T	Solid	8015B	
680-54422-9	10GP09 2 to 4ft	T	Solid	8015B	
680-54422-10	10GP10 2 to 4ft	T	Solid	8015B	

Report Basis

T = Total

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## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
<b>GC Semi VOA</b>					
<b>Prep Batch: 680-159276</b>					
LCS 680-159276/13-A	Lab Control Sample	T	Solid	3550B	
MB 680-159276/12-A	Method Blank	T	Solid	3550B	
680-54422-1	10GP01 1 to 4ft	T	Solid	3550B	
680-54422-2	10GP02 1.3 to 3.5ft	T	Solid	3550B	
680-54422-3	10GP03 2.1 to 3.4ft	T	Solid	3550B	
680-54422-4	10GP04 2 to 4ft	T	Solid	3550B	
680-54422-5	10GP05 2 to 3.3ft	T	Solid	3550B	
680-54422-6	10GP06 2 to 4ft	T	Solid	3550B	
680-54422-7	10GP07 2.5 to 4ft	T	Solid	3550B	
680-54422-8	10GP08 2 to 4ft	T	Solid	3550B	
680-54422-9	10GP09 2 to 4ft	T	Solid	3550B	
680-54422-10	10GP10 2 to 4ft	T	Solid	3550B	
680-54422-10MS	Matrix Spike	T	Solid	3550B	
680-54422-10MSD	Matrix Spike Duplicate	T	Solid	3550B	
<b>Analysis Batch:680-159481</b>					
LCS 680-159276/13-A	Lab Control Sample	T	Solid	8015B	680-159276
MB 680-159276/12-A	Method Blank	T	Solid	8015B	680-159276
680-54422-1	10GP01 1 to 4ft	T	Solid	8015B	680-159276
680-54422-2	10GP02 1.3 to 3.5ft	T	Solid	8015B	680-159276
680-54422-3	10GP03 2.1 to 3.4ft	T	Solid	8015B	680-159276
680-54422-4	10GP04 2 to 4ft	T	Solid	8015B	680-159276
680-54422-5	10GP05 2 to 3.3ft	T	Solid	8015B	680-159276
680-54422-6	10GP06 2 to 4ft	T	Solid	8015B	680-159276
680-54422-7	10GP07 2.5 to 4ft	T	Solid	8015B	680-159276
680-54422-8	10GP08 2 to 4ft	T	Solid	8015B	680-159276
680-54422-9	10GP09 2 to 4ft	T	Solid	8015B	680-159276
680-54422-10	10GP10 2 to 4ft	T	Solid	8015B	680-159276
680-54422-10MS	Matrix Spike	T	Solid	8015B	680-159276
680-54422-10MSD	Matrix Spike Duplicate	T	Solid	8015B	680-159276

Report Basis

T = Total

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
<b>Metals</b>					
<b>Prep Batch: 680-159821</b>					
LCS 680-159821/24-A	Lab Control Sample	T	Solid	3050B	
MB 680-159821/23-A	Method Blank	T	Solid	3050B	
680-54422-1	10GP01 1 to 4ft	T	Solid	3050B	
680-54422-2	10GP02 1.3 to 3.5ft	T	Solid	3050B	
680-54422-3	10GP03 2.1 to 3.4ft	T	Solid	3050B	
680-54422-4	10GP04 2 to 4ft	T	Solid	3050B	
680-54422-5	10GP05 2 to 3.3ft	T	Solid	3050B	
680-54422-6	10GP06 2 to 4ft	T	Solid	3050B	
<b>Prep Batch: 680-159984</b>					
LCS 680-159984/13-A	Lab Control Sample	T	Solid	3050B	
MB 680-159984/12-A	Method Blank	T	Solid	3050B	
680-54422-7	10GP07 2.5 to 4ft	T	Solid	3050B	
680-54422-8	10GP08 2 to 4ft	T	Solid	3050B	
680-54422-9	10GP09 2 to 4ft	T	Solid	3050B	
680-54422-10	10GP10 2 to 4ft	T	Solid	3050B	
<b>Analysis Batch:680-160423</b>					
LCS 680-159821/24-A	Lab Control Sample	T	Solid	6020	680-159821
MB 680-159821/23-A	Method Blank	T	Solid	6020	680-159821
LCS 680-159984/13-A	Lab Control Sample	T	Solid	6020	680-159984
MB 680-159984/12-A	Method Blank	T	Solid	6020	680-159984
680-54422-1	10GP01 1 to 4ft	T	Solid	6020	680-159821
680-54422-2	10GP02 1.3 to 3.5ft	T	Solid	6020	680-159821
680-54422-3	10GP03 2.1 to 3.4ft	T	Solid	6020	680-159821
680-54422-4	10GP04 2 to 4ft	T	Solid	6020	680-159821
680-54422-5	10GP05 2 to 3.3ft	T	Solid	6020	680-159821
680-54422-6	10GP06 2 to 4ft	T	Solid	6020	680-159821
680-54422-7	10GP07 2.5 to 4ft	T	Solid	6020	680-159984
680-54422-8	10GP08 2 to 4ft	T	Solid	6020	680-159984
680-54422-9	10GP09 2 to 4ft	T	Solid	6020	680-159984
680-54422-10	10GP10 2 to 4ft	T	Solid	6020	680-159984

Report Basis

T = Total



## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
General Chemistry					
Analysis Batch:680-160295					
LCS 680-160295/2	Lab Control Sample	T	Solid	9023	
MB 680-160295/1	Method Blank	T	Solid	9023	
680-54422-1	10GP01 1 to 4ft	T	Solid	9023	
680-54422-1MS	Matrix Spike	T	Solid	9023	
680-54422-1MSD	Matrix Spike Duplicate	T	Solid	9023	
680-54422-2	10GP02 1.3 to 3.5ft	T	Solid	9023	
680-54422-3	10GP03 2.1 to 3.4ft	T	Solid	9023	
680-54422-4	10GP04 2 to 4ft	T	Solid	9023	
680-54422-5	10GP05 2 to 3.3ft	T	Solid	9023	
680-54422-6	10GP06 2 to 4ft	T	Solid	9023	
680-54422-7	10GP07 2.5 to 4ft	T	Solid	9023	
680-54422-8	10GP08 2 to 4ft	T	Solid	9023	
680-54422-9	10GP09 2 to 4ft	T	Solid	9023	
680-54422-10	10GP10 2 to 4ft	T	Solid	9023	

Report Basis

T = Total

**Quality Control Results**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Surrogate Recovery Report****8260B Volatile Organic Compounds (GC/MS)****Client Matrix: Solid**

Lab Sample ID	Client Sample ID	BFB	DBFM	TOL
		%Rec	%Rec	%Rec
680-54422-1	10GP01 1 to 4ft	92	91	101
680-54422-2	10GP02 1.3 to 3.5ft	93	92	103
680-54422-3	10GP03 2.1 to 3.4ft	91	90	100
680-54422-4	10GP04 2 to 4ft	91	95	100
680-54422-5	10GP05 2 to 3.3ft	96	89	99
680-54422-6	10GP06 2 to 4ft	92	93	103
680-54422-7	10GP07 2.5 to 4ft	95	89	101
680-54422-8	10GP08 2 to 4ft	87	89	101
680-54422-9	10GP09 2 to 4ft	89	92	100
680-54422-10	10GP10 2 to 4ft	92	91	101
MB 680-159288/7		94	90	99
MB 680-159480/17		93	90	102
LCS 680-159288/5		87	80	93
LCS 680-159480/15		88	80	96
LCSD 680-159288/6		91	87	101
LCSD 680-159480/16		81	73	83

Surrogate	Acceptance Limits
BFB = 4-Bromofluorobenzene	65-124
DBFM = Dibromofluoromethane	65-124
TOL = Toluene-d8 (Surr)	65-132

**Quality Control Results**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Surrogate Recovery Report****8015B Gasoline Range Organics - (GC)****Client Matrix: Solid**

Lab Sample ID	Client Sample ID	TFT1 %Rec
680-54422-1	10GP01 1 to 4ft	93
680-54422-2	10GP02 1.3 to 3.5ft	90
680-54422-3	10GP03 2.1 to 3.4ft	94
680-54422-4	10GP04 2 to 4ft	91
680-54422-5	10GP05 2 to 3.3ft	92
680-54422-6	10GP06 2 to 4ft	91
680-54422-7	10GP07 2.5 to 4ft	90
680-54422-8	10GP08 2 to 4ft	114
680-54422-9	10GP09 2 to 4ft	97
680-54422-10	10GP10 2 to 4ft	98
MB 680-159618/17		89
LCS 680-159618/16		96
680-54422-2 MS	10GP02 1.3 to 3.5ft MS	100
680-54422-2 MSD	10GP02 1.3 to 3.5ft MSD	97

Surrogate

Acceptance Limits

TFT = a,a,a-Trifluorotoluene

53-121

**Quality Control Results**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Surrogate Recovery Report****8015B Diesel Range Organics (DRO) (GC)****Client Matrix: Solid**

Lab Sample ID	Client Sample ID	OTPH1 %Rec
680-54422-1	10GP01 1 to 4ft	106M
680-54422-2	10GP02 1.3 to 3.5ft	106M
680-54422-3	10GP03 2.1 to 3.4ft	100M
680-54422-4	10GP04 2 to 4ft	99M
680-54422-5	10GP05 2 to 3.3ft	127M
680-54422-6	10GP06 2 to 4ft	95M
680-54422-7	10GP07 2.5 to 4ft	132M
680-54422-8	10GP08 2 to 4ft	122M
680-54422-9	10GP09 2 to 4ft	115M
680-54422-10	10GP10 2 to 4ft	88M
MB 680-159276/12-A		104M
LCS 680-159276/13-A		97M
680-54422-10 MS	10GP10 2 to 4ft MS	104M
680-54422-10 MSD	10GP10 2 to 4ft MSD	94M

Surrogate	Acceptance Limits
OTPH = o-Terphenyl	39-140

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## Method Blank - Batch: 680-159288

Method: 8260B

Preparation: 5030A

Lab Sample ID: MB 680-159288/7

Analysis Batch: 680-159288

Instrument ID: MSM

Client Matrix: Solid

Prep Batch: N/A

Lab File ID: mq088.d

Dilution: 1.0

Units: ug/Kg

Initial Weight/Volume: 5 g

Date Analyzed: 01/27/2010 1046

Final Weight/Volume: 5 mL

Date Prepared: 01/27/2010 1046

Analyte	Result	Qual	DL	LOQ
Benzene	1.0	U	0.73	5.0
Ethylbenzene	1.3	U	1.3	5.0
Toluene	1.0	U	0.84	5.0
Xylenes, Total	1.1	U	1.1	10
Surrogate	% Rec	Acceptance Limits		
4-Bromofluorobenzene	94	65 - 124		
Dibromofluoromethane	90	65 - 124		
Toluene-d8 (Surr)	99	65 - 132		

Calculations are performed before rounding to avoid round-off errors in calculated results.

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Lab Control Sample/  
Lab Control Sample Duplicate Recovery Report - Batch: 680-159288****Method: 8260B  
Preparation: 5030A**

LCS Lab Sample ID: LCS 680-159288/5  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/27/2010 0915  
 Date Prepared: 01/27/2010 0915

Analysis Batch: 680-159288  
 Prep Batch: N/A  
 Units: ug/Kg

Instrument ID: MSM  
 Lab File ID: mq085.d  
 Initial Weight/Volume: 5 g  
 Final Weight/Volume: 5 mL

LCSD Lab Sample ID: LCSD 680-159288/6  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/27/2010 0937  
 Date Prepared: 01/27/2010 0937

Analysis Batch: 680-159288  
 Prep Batch: N/A  
 Units: ug/Kg

Instrument ID: MSM  
 Lab File ID: mq086.d  
 Initial Weight/Volume: 5 g  
 Final Weight/Volume: 5 mL

Analyte	% Rec.		Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
	LCS	LCSD					
Benzene	98	103	63 - 130	6	50		
Ethylbenzene	89	95	77 - 121	6	50		
Toluene	94	101	67 - 132	7	50		
Xylenes, Total	97	102	76 - 122	5	50		
Surrogate	LCS % Rec		LCSD % Rec		Acceptance Limits		
4-Bromofluorobenzene	87		91		65 - 124		
Dibromofluoromethane	80		87		65 - 124		
Toluene-d8 (Surr)	93		101		65 - 132		

**Laboratory Control/  
Laboratory Duplicate Data Report - Batch: 680-159288****Method: 8260B  
Preparation: 5030A**

LCS Lab Sample ID: LCS 680-159288/5  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/27/2010 0915  
 Date Prepared: 01/27/2010 0915

Units: ug/Kg

LCSD Lab Sample ID: LCSD 680-159288/6  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/27/2010 0937  
 Date Prepared: 01/27/2010 0937

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Benzene	50.0	50.0	48.9	51.7
Ethylbenzene	50.0	50.0	44.7	47.4
Toluene	50.0	50.0	46.9	50.4
Xylenes, Total	150	150	146	153

Calculations are performed before rounding to avoid round-off errors in calculated results.

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## Method Blank - Batch: 680-159480

Method: 8260B

Preparation: 5030A

Lab Sample ID: MB 680-159480/17

Analysis Batch: 680-159480

Instrument ID: MSM

Client Matrix: Solid

Prep Batch: N/A

Lab File ID: mq097.d

Dilution: 1.0

Units: ug/Kg

Initial Weight/Volume: 5 g

Date Analyzed: 01/28/2010 1110

Final Weight/Volume: 5 mL

Date Prepared: 01/28/2010 1110

Analyte	Result	Qual	DL	LOQ
Benzene	1.0	U	0.73	5.0
Ethylbenzene	1.3	U	1.3	5.0
Toluene	1.0	U	0.84	5.0
Xylenes, Total	1.1	U	1.1	10
Surrogate	% Rec	Acceptance Limits		
4-Bromofluorobenzene	93	65 - 124		
Dibromofluoromethane	90	65 - 124		
Toluene-d8 (Surr)	102	65 - 132		

Calculations are performed before rounding to avoid round-off errors in calculated results.

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

**Lab Control Sample/  
Lab Control Sample Duplicate Recovery Report - Batch: 680-159480****Method: 8260B  
Preparation: 5030A**LCS Lab Sample ID: LCS 680-159480/15  
Client Matrix: Solid  
Dilution: 1.0  
Date Analyzed: 01/28/2010 0939  
Date Prepared: 01/28/2010 0939Analysis Batch: 680-159480  
Prep Batch: N/A  
Units: ug/KgInstrument ID: MSM  
Lab File ID: mq094.d  
Initial Weight/Volume: 5 g  
Final Weight/Volume: 5 mLLCSD Lab Sample ID: LCSD 680-159480/16  
Client Matrix: Solid  
Dilution: 1.0  
Date Analyzed: 01/28/2010 1002  
Date Prepared: 01/28/2010 1002Analysis Batch: 680-159480  
Prep Batch: N/A  
Units: ug/KgInstrument ID: MSM  
Lab File ID: mq095.d  
Initial Weight/Volume: 5 g  
Final Weight/Volume: 5 mL

Analyte	% Rec.		Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
	LCS	LCSD					
Benzene	99	87	63 - 130	13	50		
Ethylbenzene	93	80	77 - 121	15	50		
Toluene	99	85	67 - 132	15	50		
Xylenes, Total	99	88	76 - 122	12	50		
Surrogate	LCS % Rec		LCSD % Rec		Acceptance Limits		
4-Bromofluorobenzene	88		81		65 - 124		
Dibromofluoromethane	80		73		65 - 124		
Toluene-d8 (Surr)	96		83		65 - 132		

**Laboratory Control/  
Laboratory Duplicate Data Report - Batch: 680-159480****Method: 8260B  
Preparation: 5030A**LCS Lab Sample ID: LCS 680-159480/15  
Client Matrix: Solid  
Dilution: 1.0  
Date Analyzed: 01/28/2010 0939  
Date Prepared: 01/28/2010 0939

Units: ug/Kg

LCSD Lab Sample ID: LCSD 680-159480/16  
Client Matrix: Solid  
Dilution: 1.0  
Date Analyzed: 01/28/2010 1002  
Date Prepared: 01/28/2010 1002

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Benzene	50.0	50.0	49.5	43.5
Ethylbenzene	50.0	50.0	46.5	40.1
Toluene	50.0	50.0	49.4	42.7
Xylenes, Total	150	150	148	132

Calculations are performed before rounding to avoid round-off errors in calculated results.



## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## Method Blank - Batch: 680-159618

Method: 8015B

Preparation: 5030A

Lab Sample ID: MB 680-159618/17  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/29/2010 0946  
 Date Prepared: 01/29/2010 0946

Analysis Batch: 680-159618  
 Prep Batch: N/A  
 Units: mg/Kg

Instrument ID: VGWFID1  
 Lab File ID: WQ012906.D  
 Initial Weight/Volume: 5 g  
 Final Weight/Volume: 5 mL  
 Injection Volume:  
 Column ID: PRIMARY

Analyte	Result	Qual	DL	LOQ
Gasoline Range Organics (GRO)-C6-C10	0.0500	U	0.019	0.25
Surrogate	% Rec	Acceptance Limits		
a,a,a-Trifluorotoluene	89	53 - 121		

## Lab Control Sample - Batch: 680-159618

Method: 8015B

Preparation: 5030A

Lab Sample ID: LCS 680-159618/16  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/29/2010 0920  
 Date Prepared: 01/29/2010 0920

Analysis Batch: 680-159618  
 Prep Batch: N/A  
 Units: mg/Kg

Instrument ID: VGWFID1  
 Lab File ID: WQ012905.D  
 Initial Weight/Volume: 5 g  
 Final Weight/Volume: 5 mL  
 Injection Volume:  
 Column ID: PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Gasoline Range Organics (GRO)-C6-C10	1.00	1.12	112	40 - 140	
Surrogate	% Rec	Acceptance Limits			
a,a,a-Trifluorotoluene	96	53 - 121			

Calculations are performed before rounding to avoid round-off errors in calculated results.

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## Matrix Spike/

Matrix Spike Duplicate Recovery Report - Batch: 680-159618

Method: 8015B

Preparation: 5030A

MS Lab Sample ID: 680-54422-2      Analysis Batch: 680-159618  
 Client Matrix: Solid      Prep Batch: N/A  
 Dilution: 1.0  
 Date Analyzed: 01/29/2010 1518  
 Date Prepared: 01/29/2010 1518

Instrument ID: VGWFID1  
 Lab File ID: W012913.D  
 Initial Weight/Volume: 5 g  
 Final Weight/Volume: 5 mL  
 Injection Volume:  
 Column ID: PRIMARY

MSD Lab Sample ID: 680-54422-2      Analysis Batch: 680-159618  
 Client Matrix: Solid      Prep Batch: N/A  
 Dilution: 1.0  
 Date Analyzed: 01/29/2010 1543  
 Date Prepared: 01/29/2010 1543

Instrument ID: VGWFID1  
 Lab File ID: W012914.D  
 Initial Weight/Volume: 5 g  
 Final Weight/Volume: 5 mL  
 Injection Volume:  
 Column ID: PRIMARY

Analyte	% Rec.		Limit	RPD	RPD Limit	MS Qual	MSD Qual
	MS	MSD					
Gasoline Range Organics (GRO)-C6-C10	83	83	40 - 140	0	40		

Surrogate	MS % Rec	MSD % Rec	Acceptance Limits
a,a,a-Trifluorotoluene	100	97	53 - 121

## Matrix Spike/

Matrix Spike Duplicate Data Report - Batch: 680-159618

Method: 8015B

Preparation: 5030A

MS Lab Sample ID: 680-54422-2      Units: mg/Kg  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/29/2010 1518  
 Date Prepared: 01/29/2010 1518

MSD Lab Sample ID: 680-54422-2  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/29/2010 1543  
 Date Prepared: 01/29/2010 1543

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Gasoline Range Organics (GRO)-C6-C10	0.0575 U	1.15	1.15	0.949	0.949

Calculations are performed before rounding to avoid round-off errors in calculated results.

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## Method Blank - Batch: 680-159276

Method: 8015B

Preparation: 3550B

Lab Sample ID: MB 680-159276/12-A  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/28/2010 0934  
 Date Prepared: 01/27/2010 1300

Analysis Batch: 680-159481  
 Prep Batch: 680-159276  
 Units: mg/Kg

Instrument ID: SGQ  
 Lab File ID: qa280008.d  
 Initial Weight/Volume: 30.03 g  
 Final Weight/Volume: 1 mL  
 Injection Volume: 2 uL  
 Column ID: PRIMARY

Analyte	Result	Qual	DL	LOQ
Diesel Range Organics [C10-C28]	2.1	U	2.1	3.3

Surrogate	% Rec	Acceptance Limits
o-Terphenyl	104 M	39 - 140

## Lab Control Sample - Batch: 680-159276

Method: 8015B

Preparation: 3550B

Lab Sample ID: LCS 680-159276/13-A  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/28/2010 0944  
 Date Prepared: 01/27/2010 1300

Analysis Batch: 680-159481  
 Prep Batch: 680-159276  
 Units: mg/Kg

Instrument ID: SGQ  
 Lab File ID: qa280009.d  
 Initial Weight/Volume: 30.05 g  
 Final Weight/Volume: 1 mL  
 Injection Volume: 2 uL  
 Column ID: PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Diesel Range Organics [C10-C28]	33.3	34.6	104	40 - 140	M

Surrogate	% Rec	Acceptance Limits
o-Terphenyl	97 M	39 - 140

Calculations are performed before rounding to avoid round-off errors in calculated results.

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## Matrix Spike/

Matrix Spike Duplicate Recovery Report - Batch: 680-159276

Method: 8015B

Preparation: 3550B

MS Lab Sample ID: 680-54422-10  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/28/2010 1205  
 Date Prepared: 01/27/2010 1300

Analysis Batch: 680-159481  
 Prep Batch: 680-159276

Instrument ID: SGQ  
 Lab File ID: qa280022.d  
 Initial Weight/Volume: 30.17 g  
 Final Weight/Volume: 1 mL  
 Injection Volume: 2 uL  
 Column ID: PRIMARY

MSD Lab Sample ID: 680-54422-10  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/28/2010 1216  
 Date Prepared: 01/27/2010 1300

Analysis Batch: 680-159481  
 Prep Batch: 680-159276

Instrument ID: SGQ  
 Lab File ID: qa280023.d  
 Initial Weight/Volume: 30.07 g  
 Final Weight/Volume: 1 mL  
 Injection Volume: 2 uL  
 Column ID: PRIMARY

Analyte	% Rec.		Limit	RPD	RPD Limit	MS Qual	MSD Qual
	MS	MSD					
Diesel Range Organics [C10-C28]	100	72	40 - 140	21	40	M	M

Surrogate	MS % Rec		MSD % Rec	Acceptance Limits
o-Terphenyl	104	M		
			94	M
				39 - 140

## Matrix Spike/

Matrix Spike Duplicate Data Report - Batch: 680-159276

Method: 8015B

Preparation: 3550B

MS Lab Sample ID: 680-54422-10  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/28/2010 1205  
 Date Prepared: 01/27/2010 1300

Units: mg/Kg

MSD Lab Sample ID: 680-54422-10  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 01/28/2010 1216  
 Date Prepared: 01/27/2010 1300

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Diesel Range Organics [C10-C28]	19	38.8	39.0	57.4 M	46.6 M

Calculations are performed before rounding to avoid round-off errors in calculated results.

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## Method Blank - Batch: 680-159821

Method: 6020

Preparation: 3050B

Lab Sample ID: MB 680-159821/23-A

Client Matrix: Solid

Dilution: 1.0

Date Analyzed: 02/08/2010 1824

Date Prepared: 02/03/2010 1011

Analysis Batch: 680-160423

Prep Batch: 680-159821

Units: mg/Kg

Instrument ID: ICPMSB

Lab File ID: N/A

Initial Weight/Volume: 1.00 g

Final Weight/Volume: 1000 mL

Analyte	Result	Qual	DL	LOQ
Antimony	1.0	U	1.0	2.0
Arsenic	0.25	U	0.20	0.50
Beryllium	0.0500	U	0.050	0.10
Cadmium	0.0500	U Q	0.024	0.10
Chromium	0.50	U	0.50	1.0
Copper	0.50	U Q	0.40	1.0
Lead	0.20	U	0.20	0.40
Mercury	0.0800	U	0.080	0.20
Nickel	0.50	U Q	0.11	0.20
Selenium	0.50	U	0.50	1.0
Silver	0.10	U	0.10	0.20
Thallium	0.0500	U	0.050	0.20
Zinc	3.0	U	1.1	4.0

## Lab Control Sample - Batch: 680-159821

Method: 6020

Preparation: 3050B

Lab Sample ID: LCS 680-159821/24-A

Client Matrix: Solid

Dilution: 1.0

Date Analyzed: 02/08/2010 1831

Date Prepared: 02/03/2010 1011

Analysis Batch: 680-160423

Prep Batch: 680-159821

Units: mg/Kg

Instrument ID: ICPMSB

Lab File ID: N/A

Initial Weight/Volume: 1.00 g

Final Weight/Volume: 1000 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Antimony	5.00	4.80	96	75 - 125	
Arsenic	10.0	9.36	94	75 - 125	
Beryllium	5.00	4.34	87	75 - 125	
Cadmium	5.00	4.69	94	75 - 125	Q
Chromium	10.0	9.49	95	75 - 125	
Copper	10.0	9.78	98	75 - 125	Q
Lead	5.00	5.09	102	75 - 125	
Mercury	0.500	0.472	94	75 - 125	
Nickel	10.0	9.86	99	75 - 125	Q
Selenium	10.0	9.04	90	75 - 125	
Silver	5.00	4.99	100	75 - 125	
Thallium	4.00	3.88	97	75 - 125	
Zinc	10.0	9.15	92	75 - 125	

Calculations are performed before rounding to avoid round-off errors in calculated results.

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## Method Blank - Batch: 680-159984

Method: 6020

Preparation: 3050B

Lab Sample ID: MB 680-159984/12-A

Analysis Batch: 680-160423

Instrument ID: ICPMSB

Client Matrix: Solid

Prep Batch: 680-159984

Lab File ID: N/A

Dilution: 1.0

Units: mg/Kg

Initial Weight/Volume: 1.00 g

Date Analyzed: 02/08/2010 2135

Final Weight/Volume: 1000 mL

Date Prepared: 02/04/2010 1459

Analyte	Result	Qual	DL	LOQ
Antimony	1.0	U	1.0	2.0
Arsenic	0.25	U	0.20	0.50
Beryllium	0.0500	U	0.050	0.10
Cadmium	0.0500	U Q	0.024	0.10
Chromium	0.50	U	0.50	1.0
Copper	0.50	U Q	0.40	1.0
Lead	0.20	U	0.20	0.40
Mercury	0.0800	U	0.080	0.20
Nickel	0.50	U Q	0.11	0.20
Selenium	0.50	U	0.50	1.0
Silver	0.10	U	0.10	0.20
Thallium	0.0500	U	0.050	0.20
Zinc	3.0	U	1.1	4.0

## Lab Control Sample - Batch: 680-159984

Method: 6020

Preparation: 3050B

Lab Sample ID: LCS 680-159984/13-A

Analysis Batch: 680-160423

Instrument ID: ICPMSB

Client Matrix: Solid

Prep Batch: 680-159984

Lab File ID: N/A

Dilution: 1.0

Units: mg/Kg

Initial Weight/Volume: 1.00 g

Date Analyzed: 02/08/2010 2142

Final Weight/Volume: 1000 mL

Date Prepared: 02/04/2010 1459

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Antimony	5.00	5.16	103	75 - 125	
Arsenic	10.0	10.2	102	75 - 125	
Beryllium	5.00	4.60	92	75 - 125	
Cadmium	5.00	5.07	101	75 - 125	Q
Chromium	10.0	9.87	99	75 - 125	
Copper	10.0	10.3	103	75 - 125	Q
Lead	5.00	5.34	107	75 - 125	
Mercury	0.500	0.510	102	75 - 125	
Nickel	10.0	10.4	104	75 - 125	Q
Selenium	10.0	9.52	95	75 - 125	
Silver	5.00	5.31	106	75 - 125	
Thallium	4.00	4.08	102	75 - 125	
Zinc	10.0	10.2	102	75 - 125	

Calculations are performed before rounding to avoid round-off errors in calculated results.

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

Sdg Number: 680-54422-1

## Method Blank - Batch: 680-160295

Method: 9023

Preparation: N/A

Lab Sample ID: MB 680-160295/1  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 02/09/2010 0800  
 Date Prepared: N/A

Analysis Batch: 680-160295  
 Prep Batch: N/A  
 Units: mg/Kg

Instrument ID: EURO1  
 Lab File ID: N/A  
 Initial Weight/Volume: 2 g  
 Final Weight/Volume: 10 mL

Analyte	Result	Qual	DL	LOQ
Halogens, Extractable Organic	10	U	10	20

## Lab Control Sample - Batch: 680-160295

Method: 9023

Preparation: N/A

Lab Sample ID: LCS 680-160295/2  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 02/09/2010 0800  
 Date Prepared: N/A

Analysis Batch: 680-160295  
 Prep Batch: N/A  
 Units: mg/Kg

Instrument ID: EURO1  
 Lab File ID: N/A  
 Initial Weight/Volume: 2 g  
 Final Weight/Volume: 10 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Halogens, Extractable Organic	50.0	40.8	82	60 - 140	

## Matrix Spike/

## Matrix Spike Duplicate Recovery Report - Batch: 680-160295

Method: 9023

Preparation: N/A

MS Lab Sample ID: 680-54422-1  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 02/09/2010 0800  
 Date Prepared: N/A

Analysis Batch: 680-160295  
 Prep Batch: N/A

Instrument ID: EURO1  
 Lab File ID: N/A  
 Initial Weight/Volume: 2 g  
 Final Weight/Volume: 10 mL

MSD Lab Sample ID: 680-54422-1  
 Client Matrix: Solid  
 Dilution: 1.0  
 Date Analyzed: 02/09/2010 0800  
 Date Prepared: N/A

Analysis Batch: 680-160295  
 Prep Batch: N/A

Instrument ID: EURO1  
 Lab File ID: N/A  
 Initial Weight/Volume: 2 g  
 Final Weight/Volume: 10 mL

Analyte	% Rec.		Limit	RPD	RPD Limit	MS Qual	MSD Qual
	MS	MSD					
Halogens, Extractable Organic	87	63	60 - 140	23	50		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quality Control Results

Client: S&ME, Inc.

Job Number: 680-54422-1  
Sdg Number: 680-54422-1

Matrix Spike/  
Matrix Spike Duplicate Data Report - Batch: 680-160295

Method: 9023  
Preparation: N/A

MS Lab Sample ID: 680-54422-1  
Client Matrix: Solid  
Dilution: 1.0  
Date Analyzed: 02/09/2010 0800  
Date Prepared: N/A

Units: mg/Kg

MSD Lab Sample ID: 680-54422-1  
Client Matrix: Solid  
Dilution: 1.0  
Date Analyzed: 02/09/2010 0800  
Date Prepared: N/A

Analyte	Sample Result/Qual		MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Halogens, Extractable Organic	16	J	55.9	55.9	65.0	51.5



## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

SDG: 680-54422-1

## Laboratory Chronicle

Lab ID: 680-54422-1

Client ID: 10GP01 1 to 4ft

Sample Date/Time: 01/20/2010 11:14

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-1		680-159288		01/27/2010 15:08	1	TAL SAV	ES
A:8260B	680-54422-E-1		680-159288		01/27/2010 15:08	1	TAL SAV	ES
P:5030A	680-54422-C-1		680-159618		01/29/2010 10:39	1	TAL SAV	AEM
A:8015B	680-54422-C-1		680-159618		01/29/2010 10:39	1	TAL SAV	AEM
P:3550B	680-54422-A-1-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-1-A		680-159481	680-159276	01/28/2010 09:55	1	TAL SAV	CAS
P:3050B	680-54422-A-1-B		680-160423	680-159821	02/03/2010 10:11	1	TAL SAV	DH
A:6020	680-54422-A-1-B		680-160423	680-159821	02/08/2010 20:24	1	TAL SAV	BB
A:9023	680-54422-A-1		680-160295		02/09/2010 08:00	1	TAL SAV	CN

Lab ID: 680-54422-1 MS

Client ID: 10GP01 1 to 4ft

Sample Date/Time: 01/20/2010 11:14

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
A:9023	680-54422-A-1 MS		680-160295		02/09/2010 08:00	1	TAL SAV	CN

Lab ID: 680-54422-1 MSD

Client ID: 10GP01 1 to 4ft

Sample Date/Time: 01/20/2010 11:14

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
A:9023	680-54422-A-1 MSD		680-160295		02/09/2010 08:00	1	TAL SAV	CN

Lab ID: 680-54422-2

Client ID: 10GP02 1.3 to 3.5ft

Sample Date/Time: 01/20/2010 11:59

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-2		680-159288		01/27/2010 15:31	1	TAL SAV	ES
A:8260B	680-54422-E-2		680-159288		01/27/2010 15:31	1	TAL SAV	ES
P:5030A	680-54422-B-2		680-159618		01/29/2010 11:04	1	TAL SAV	AEM
A:8015B	680-54422-B-2		680-159618		01/29/2010 11:04	1	TAL SAV	AEM
P:3550B	680-54422-A-2-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-2-A		680-159481	680-159276	01/28/2010 10:17	1	TAL SAV	CAS
P:3050B	680-54422-A-2-B		680-160423	680-159821	02/03/2010 10:11	1	TAL SAV	DH
A:6020	680-54422-A-2-B		680-160423	680-159821	02/08/2010 20:31	1	TAL SAV	BB
A:9023	680-54422-A-2		680-160295		02/09/2010 08:00	1	TAL SAV	CN

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

SDG: 680-54422-1

## Laboratory Chronicle

Lab ID: 680-54422-2 MS

Client ID: 10GP02 1.3 to 3.5ft

Sample Date/Time: 01/20/2010 11:59

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-B-2 MS		680-159618		01/29/2010 15:18	1	TAL SAV	AEM
A:8015B	680-54422-B-2 MS		680-159618		01/29/2010 15:18	1	TAL SAV	AEM

Lab ID: 680-54422-2 MSD

Client ID: 10GP02 1.3 to 3.5ft

Sample Date/Time: 01/20/2010 11:59

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-B-2 MSD		680-159618		01/29/2010 15:43	1	TAL SAV	AEM
A:8015B	680-54422-B-2 MSD		680-159618		01/29/2010 15:43	1	TAL SAV	AEM

Lab ID: 680-54422-3

Client ID: 10GP03 2.1 to 3.4ft

Sample Date/Time: 01/20/2010 12:24

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-3		680-159288		01/27/2010 15:54	1	TAL SAV	ES
A:8260B	680-54422-E-3		680-159288		01/27/2010 15:54	1	TAL SAV	ES
P:5030A	680-54422-D-3		680-159618		01/29/2010 11:28	1	TAL SAV	AEM
A:8015B	680-54422-D-3		680-159618		01/29/2010 11:28	1	TAL SAV	AEM
P:3550B	680-54422-A-3-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-3-A		680-159481	680-159276	01/28/2010 10:28	1	TAL SAV	CAS
P:3050B	680-54422-A-3-B		680-160423	680-159821	02/03/2010 10:11	1	TAL SAV	DH
A:6020	680-54422-A-3-B		680-160423	680-159821	02/08/2010 20:38	1	TAL SAV	BB
A:9023	680-54422-A-3		680-160295		02/09/2010 08:00	1	TAL SAV	CN

Lab ID: 680-54422-4

Client ID: 10GP04 2 to 4ft

Sample Date/Time: 01/20/2010 12:54

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-4		680-159288		01/27/2010 16:17	1	TAL SAV	ES
A:8260B	680-54422-E-4		680-159288		01/27/2010 16:17	1	TAL SAV	ES
P:5030A	680-54422-B-4		680-159618		01/29/2010 11:53	1	TAL SAV	AEM
A:8015B	680-54422-B-4		680-159618		01/29/2010 11:53	1	TAL SAV	AEM
P:3550B	680-54422-A-4-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-4-A		680-159481	680-159276	01/28/2010 10:39	1	TAL SAV	CAS
P:3050B	680-54422-A-4-B		680-160423	680-159821	02/03/2010 10:11	1	TAL SAV	DH
A:6020	680-54422-A-4-B		680-160423	680-159821	02/08/2010 20:45	1	TAL SAV	BB
A:9023	680-54422-A-4		680-160295		02/09/2010 08:00	1	TAL SAV	CN

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

SDG: 680-54422-1

## Laboratory Chronicle

Lab ID: 680-54422-5

Client ID: 10GP05 2 to 3.3ft

Sample Date/Time: 01/20/2010 13:21

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-5		680-159480		01/28/2010 12:11	1	TAL SAV	ES
A:8260B	680-54422-E-5		680-159480		01/28/2010 12:11	1	TAL SAV	ES
P:5030A	680-54422-B-5		680-159618		01/29/2010 12:18	1	TAL SAV	AEM
A:8015B	680-54422-B-5		680-159618		01/29/2010 12:18	1	TAL SAV	AEM
P:3550B	680-54422-A-5-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-5-A		680-159481	680-159276	01/28/2010 10:49	1	TAL SAV	CAS
P:3050B	680-54422-A-5-B		680-160423	680-159821	02/03/2010 10:11	1	TAL SAV	DH
A:6020	680-54422-A-5-B		680-160423	680-159821	02/08/2010 20:52	1	TAL SAV	BB
A:9023	680-54422-A-5		680-160295		02/09/2010 08:00	1	TAL SAV	CN

Lab ID: 680-54422-6

Client ID: 10GP06 2 to 4ft

Sample Date/Time: 01/20/2010 13:40

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-6		680-159288		01/27/2010 17:02	1	TAL SAV	ES
A:8260B	680-54422-E-6		680-159288		01/27/2010 17:02	1	TAL SAV	ES
P:5030A	680-54422-B-6		680-159618		01/29/2010 12:42	1	TAL SAV	AEM
A:8015B	680-54422-B-6		680-159618		01/29/2010 12:42	1	TAL SAV	AEM
P:3550B	680-54422-A-6-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-6-A		680-159481	680-159276	01/28/2010 11:00	1	TAL SAV	CAS
P:3050B	680-54422-A-6-B		680-160423	680-159821	02/03/2010 10:11	1	TAL SAV	DH
A:6020	680-54422-A-6-B		680-160423	680-159821	02/08/2010 21:14	1	TAL SAV	BB
A:9023	680-54422-A-6		680-160295		02/09/2010 08:00	1	TAL SAV	CN

Lab ID: 680-54422-7

Client ID: 10GP07 2.5 to 4ft

Sample Date/Time: 01/20/2010 14:23

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-7		680-159288		01/27/2010 17:25	1	TAL SAV	ES
A:8260B	680-54422-E-7		680-159288		01/27/2010 17:25	1	TAL SAV	ES
P:5030A	680-54422-B-7		680-159618		01/29/2010 13:04	1	TAL SAV	AEM
A:8015B	680-54422-B-7		680-159618		01/29/2010 13:04	1	TAL SAV	AEM
P:3550B	680-54422-A-7-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-7-A		680-159481	680-159276	01/28/2010 11:11	1	TAL SAV	CAS
P:3050B	680-54422-A-7-B		680-160423	680-159984	02/04/2010 14:59	1	TAL SAV	DH
A:6020	680-54422-A-7-B		680-160423	680-159984	02/08/2010 21:49	1	TAL SAV	BB
A:9023	680-54422-A-7		680-160295		02/09/2010 08:00	1	TAL SAV	CN

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

SDG: 680-54422-1

## Laboratory Chronicle

Lab ID: 680-54422-8

Client ID: 10GP08 2 to 4ft

Sample Date/Time: 01/20/2010 14:40

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-8		680-159288		01/27/2010 17:47	1	TAL SAV	ES
A:8260B	680-54422-E-8		680-159288		01/27/2010 17:47	1	TAL SAV	ES
P:5030A	680-54422-C-8		680-159618		01/29/2010 13:29	1	TAL SAV	AEM
A:8015B	680-54422-C-8		680-159618		01/29/2010 13:29	1	TAL SAV	AEM
P:3550B	680-54422-A-8-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-8-A		680-159481	680-159276	01/28/2010 11:22	1	TAL SAV	CAS
P:3050B	680-54422-A-8-B		680-160423	680-159984	02/04/2010 14:59	1	TAL SAV	DH
A:6020	680-54422-A-8-B		680-160423	680-159984	02/08/2010 21:56	1	TAL SAV	BB
A:9023	680-54422-A-8		680-160295		02/09/2010 08:00	1	TAL SAV	CN

Lab ID: 680-54422-9

Client ID: 10GP09 2 to 4ft

Sample Date/Time: 01/20/2010 15:00

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-9		680-159288		01/27/2010 18:10	1	TAL SAV	ES
A:8260B	680-54422-E-9		680-159288		01/27/2010 18:10	1	TAL SAV	ES
P:5030A	680-54422-D-9		680-159618		01/29/2010 13:54	1	TAL SAV	AEM
A:8015B	680-54422-D-9		680-159618		01/29/2010 13:54	1	TAL SAV	AEM
P:3550B	680-54422-A-9-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-9-A		680-159481	680-159276	01/28/2010 11:43	1	TAL SAV	CAS
P:3050B	680-54422-A-9-B		680-160423	680-159984	02/04/2010 14:59	1	TAL SAV	DH
A:6020	680-54422-A-9-B		680-160423	680-159984	02/08/2010 22:03	1	TAL SAV	BB
A:9023	680-54422-A-9		680-160295		02/09/2010 08:00	1	TAL SAV	CN

Lab ID: 680-54422-10

Client ID: 10GP10 2 to 4ft

Sample Date/Time: 01/20/2010 15:27

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	680-54422-E-10		680-159288		01/27/2010 18:33	1	TAL SAV	ES
A:8260B	680-54422-E-10		680-159288		01/27/2010 18:33	1	TAL SAV	ES
P:5030A	680-54422-D-10		680-159618		01/29/2010 14:53	1	TAL SAV	AEM
A:8015B	680-54422-D-10		680-159618		01/29/2010 14:53	1	TAL SAV	AEM
P:3550B	680-54422-A-10-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-10-A		680-159481	680-159276	01/28/2010 11:54	1	TAL SAV	CAS
P:3050B	680-54422-A-10-D		680-160423	680-159984	02/04/2010 14:59	1	TAL SAV	DH
A:6020	680-54422-A-10-D		680-160423	680-159984	02/08/2010 22:10	1	TAL SAV	BB
A:9023	680-54422-A-10		680-160295		02/09/2010 08:00	1	TAL SAV	CN

## Quality Control Results

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

SDG: 680-54422-1

## Laboratory Chronicle

Lab ID: 680-54422-10 MS

Client ID: 10GP10 2 to 4ft

Sample Date/Time: 01/20/2010 15:27

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3550B	680-54422-A-10-B MS		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-10-B MS		680-159481	680-159276	01/28/2010 12:05	1	TAL SAV	CAS

Lab ID: 680-54422-10 MSD

Client ID: 10GP10 2 to 4ft

Sample Date/Time: 01/20/2010 15:27

Received Date/Time: 01/22/2010 09:09

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3550B	680-54422-A-10-C MSD		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	680-54422-A-10-C MSD		680-159481	680-159276	01/28/2010 12:16	1	TAL SAV	CAS

Lab ID: MB

Client ID: N/A

Sample Date/Time: N/A

Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	MB 680-159288/7		680-159288		01/27/2010 10:46	1	TAL SAV	ES
A:8260B	MB 680-159288/7		680-159288		01/27/2010 10:46	1	TAL SAV	ES
P:5030A	MB 680-159480/17		680-159480		01/28/2010 11:10	1	TAL SAV	ES
A:8260B	MB 680-159480/17		680-159480		01/28/2010 11:10	1	TAL SAV	ES
P:5030A	MB 680-159618/17		680-159618		01/29/2010 09:46	1	TAL SAV	AEM
A:8015B	MB 680-159618/17		680-159618		01/29/2010 09:46	1	TAL SAV	AEM
P:3550B	MB 680-159276/12-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	MB 680-159276/12-A		680-159481	680-159276	01/28/2010 09:34	1	TAL SAV	CAS
P:3050B	MB 680-159821/23-A		680-160423	680-159821	02/03/2010 10:11	1	TAL SAV	DH
A:6020	MB 680-159821/23-A		680-160423	680-159821	02/08/2010 18:24	1	TAL SAV	BB
P:3050B	MB 680-159984/12-A		680-160423	680-159984	02/04/2010 14:59	1	TAL SAV	DH
A:6020	MB 680-159984/12-A		680-160423	680-159984	02/08/2010 21:35	1	TAL SAV	BB
A:9023	MB 680-160295/1		680-160295		02/09/2010 08:00	1	TAL SAV	CN

**Quality Control Results**

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

SDG: 680-54422-1

**Laboratory Chronicle**

Lab ID: LCS

Client ID: N/A

Sample Date/Time: N/A

Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	LCS 680-159288/5		680-159288		01/27/2010 09:15	1	TAL SAV	ES
A:8260B	LCS 680-159288/5		680-159288		01/27/2010 09:15	1	TAL SAV	ES
P:5030A	LCS 680-159480/15		680-159480		01/28/2010 09:39	1	TAL SAV	ES
A:8260B	LCS 680-159480/15		680-159480		01/28/2010 09:39	1	TAL SAV	ES
P:5030A	LCS 680-159618/16		680-159618		01/29/2010 09:20	1	TAL SAV	AEM
A:8015B	LCS 680-159618/16		680-159618		01/29/2010 09:20	1	TAL SAV	AEM
P:3550B	LCS 680-159276/13-A		680-159481	680-159276	01/27/2010 13:00	1	TAL SAV	WB
A:8015B	LCS 680-159276/13-A		680-159481	680-159276	01/28/2010 09:44	1	TAL SAV	CAS
P:3050B	LCS 680-159821/24-A		680-160423	680-159821	02/03/2010 10:11	1	TAL SAV	DH
A:6020	LCS 680-159821/24-A		680-160423	680-159821	02/08/2010 18:31	1	TAL SAV	BB
P:3050B	LCS 680-159984/13-A		680-160423	680-159984	02/04/2010 14:59	1	TAL SAV	DH
A:6020	LCS 680-159984/13-A		680-160423	680-159984	02/08/2010 21:42	1	TAL SAV	BB
A:9023	LCS 680-160295/2		680-160295		02/09/2010 08:00	1	TAL SAV	CN

Lab ID: LCSD

Client ID: N/A

Sample Date/Time: N/A

Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5030A	LCSD 680-159288/6		680-159288		01/27/2010 09:37	1	TAL SAV	ES
A:8260B	LCSD 680-159288/6		680-159288		01/27/2010 09:37	1	TAL SAV	ES
P:5030A	LCSD 680-159480/16		680-159480		01/28/2010 10:02	1	TAL SAV	ES
A:8260B	LCSD 680-159480/16		680-159480		01/28/2010 10:02	1	TAL SAV	ES

**Lab References:**

TAL SAV = TestAmerica Savannah



## Login Sample Receipt Check List

Client: S&amp;ME, Inc.

Job Number: 680-54422-1

SDG Number: 680-54422-1

Login Number: 54422

Creator: Daughtry, Beth

List Number: 1

List Source: TestAmerica Savannah

Question	T / F / NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	2 coolers rec'd on ice.
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	3.8 and 3.5 C
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	False	Rec'd Trip Blank - not listed on COC
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	True	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	N/A	
Samples do not require splitting or compositing.	N/A	
Is the Field Sampler's name present on COC?	True	
Sample Preservation Verified	True	



Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX F

### Conceptual Aesthetic Considerations

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

For Guidance Concerning Conceptual Aesthetic  
Considerations, Refer to Appendix CC “Design  
Compatibility Guidelines, Langley Air Force Base, VA”

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX G

GIS Data

Not Used

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX H

### Exterior Signage

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

**For signage guidance, refer to Appendix CC “Design  
Compatibility Guidelines – Langley Air Force Base VA”**

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX I

### Acceptable Plants List



Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

**For Signage Guidance, Refer to Appendix CC “Design  
Compatibility Guidelines, Langley Air Force Base, VA”**

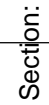
Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX J

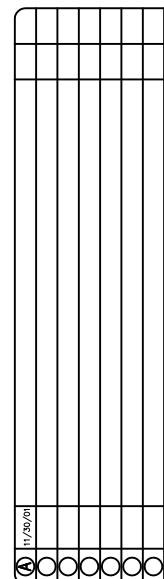
### Drawings

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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NORFOLK DISTRICT CORPS OF ENGINEERS NORFOLK, VIRGINIA	DESIGNED: JCW	CHECKED:	DATE: OCT. 2001
	DRAWN: FBS	SUBMITTED:	SCALE: AS SHOWN
	PROJECT NO. HACC023010	NORFOLK DISTRICT FILE NO. LF-422-1,336	
	DRAWING NO. 171-18-13	SPECIFICATION NO. DAC605-01-R-0025	
BURNS & McDONNELL 9400 WARD PARKWAY KANSAS CITY, MISSOURI 64114	Last worked on: Plot scale: 1:1		

F-22 OPERATIONS AND MAINTENANCE  
FACILITIES  
LANGLEY AIR FORCE BASE, VIRGINIA

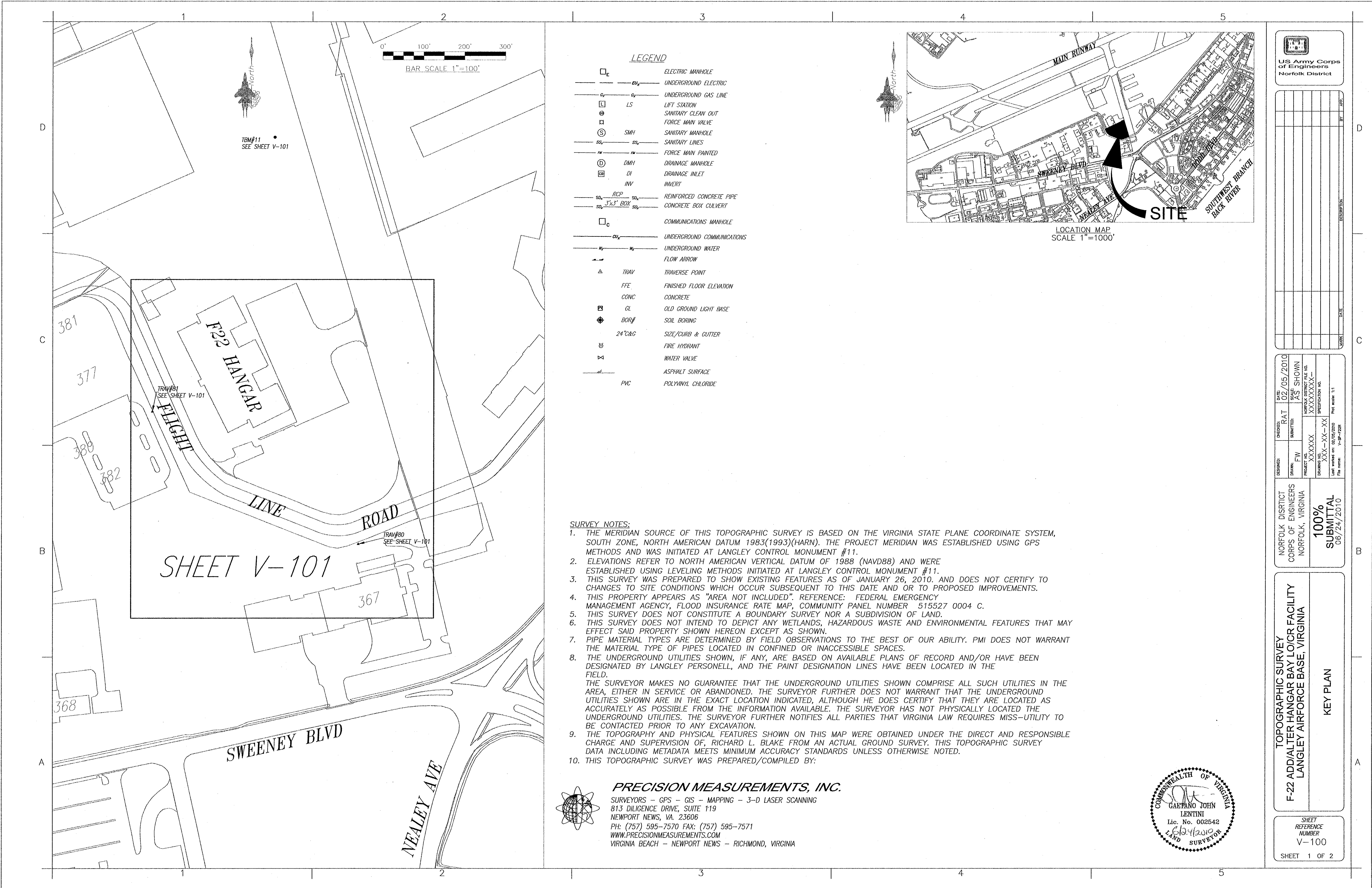
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LO/CR FACILITY  
COVER SHEET

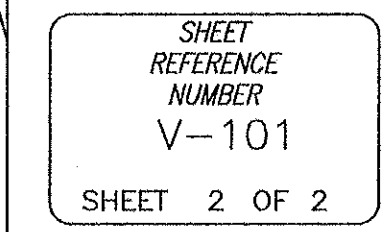
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A key plan of the site showing five areas (A-E) and a north arrow. The plan is divided into five areas: AREA-A, AREA-B, AREA-C, AREA-D, and AREA-E. The areas are labeled with letters A through E. The plan also shows a north arrow pointing towards the top right. The plan is not to scale.

 **KEY PLAN**  
NOT TO SCALE





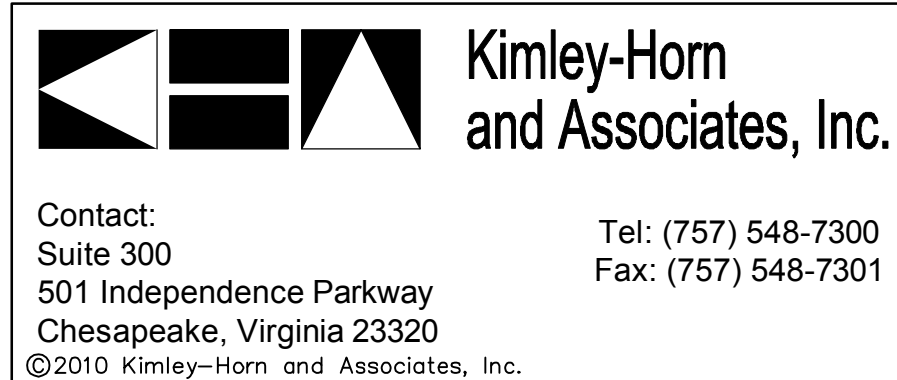




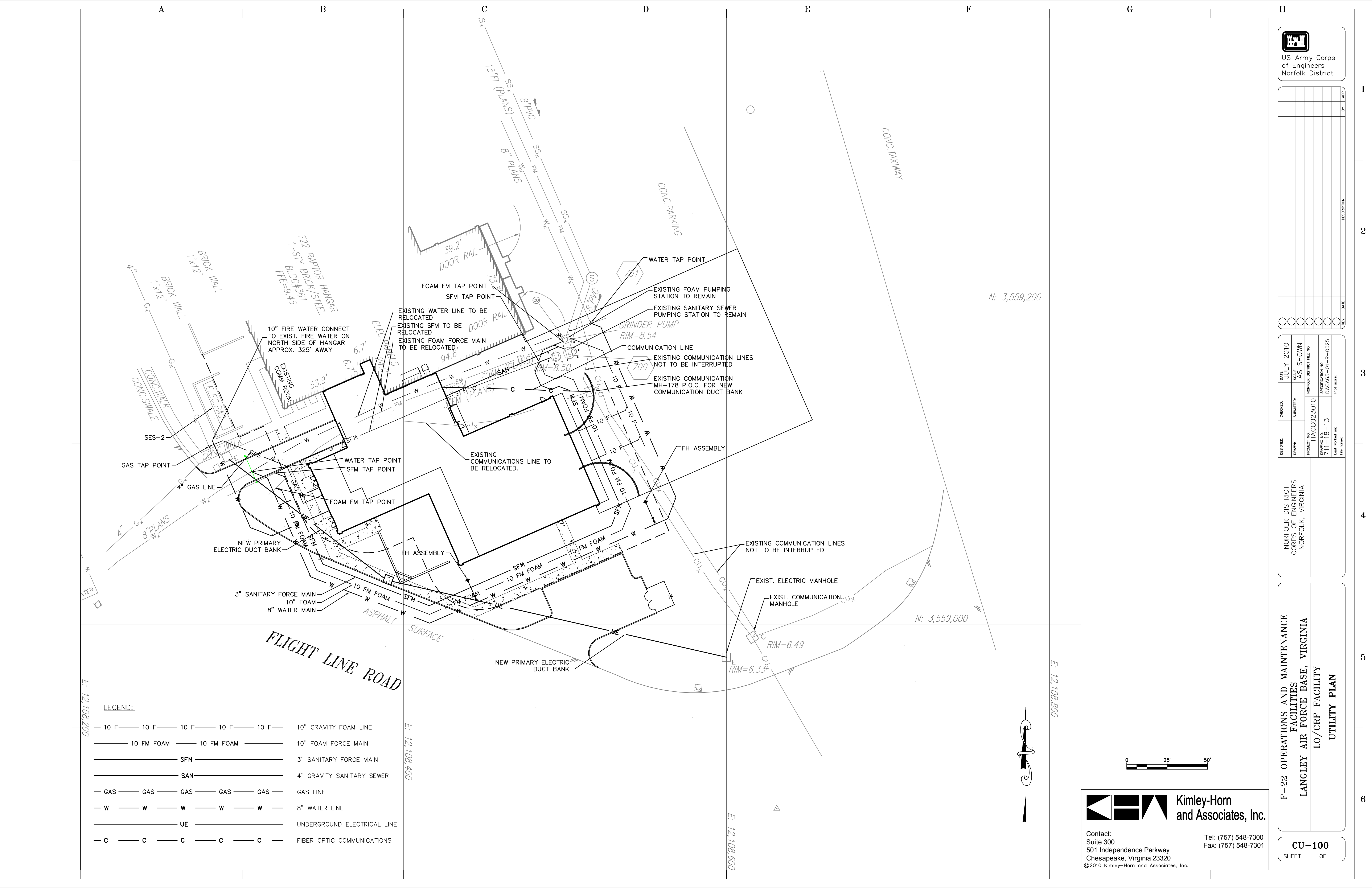


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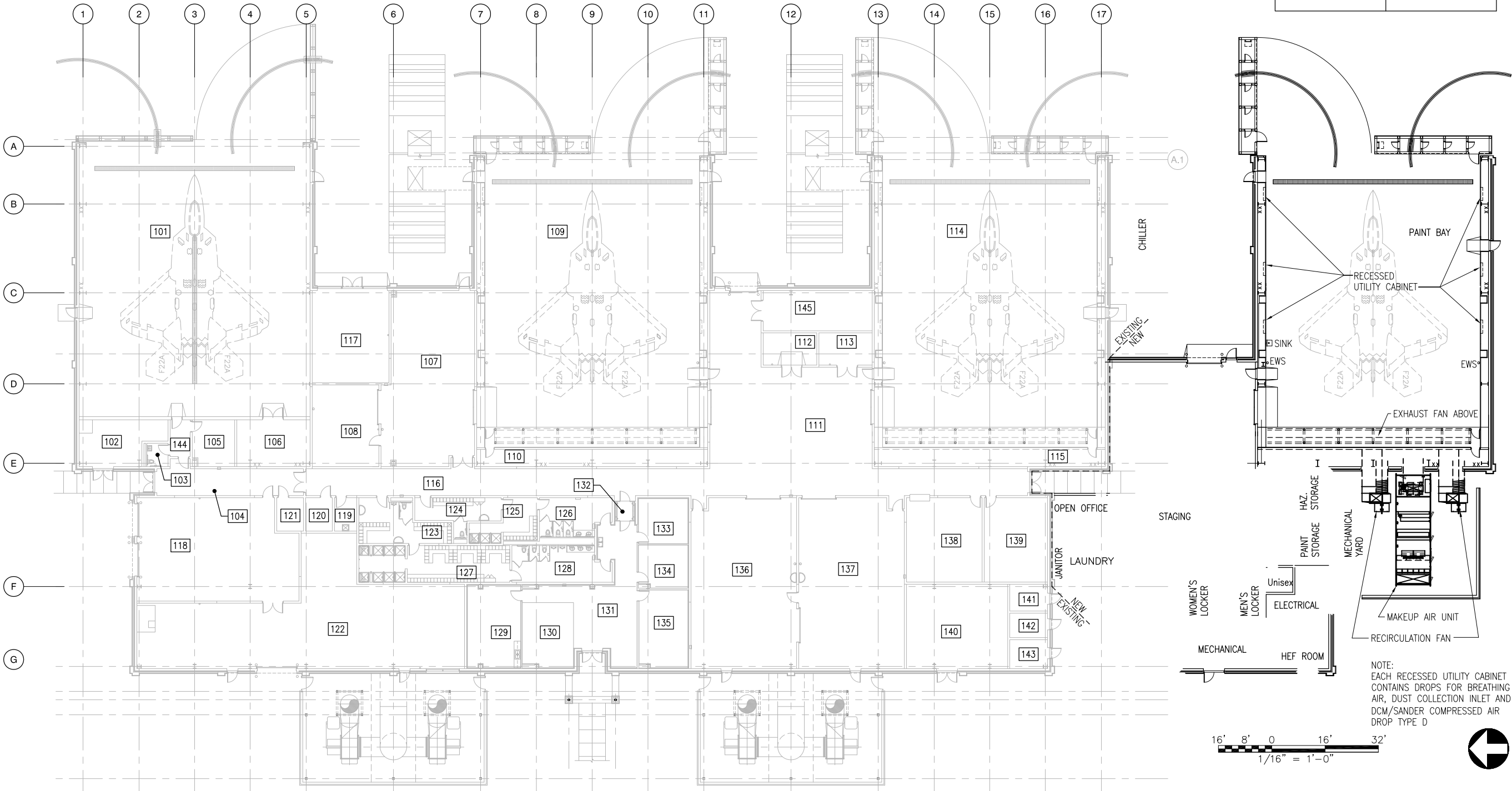




ROOM DESIGNATIONS :

101 WASH BAY	111 STAGING AREA	121 ELECTRICAL ROOM #2	131 ENTRY/ CIRC.	141 SATELLITE ACCUM. POINT 1
102 FIRE PROTECTION EQUIPMENT ROOM	112 COMPOSITE AND PAINT STORAGE	122 MECHANICAL ROOM	132 AIR SHOWER	142 SATELLITE ACCUM. POINT 2
103 UNI-SEX TOILET	113 HAZ STOR	123 MEN'S DECONTAMINATION	133 AFET/FSR	143 COMMUNICATIONS ROOM #1
104 SERVICE CORRIDOR #1	114 COATINGS RESTORATION BAY	124 WOMEN'S DECONTAMINATION	134 ASM OFFICE	144 SERVICE CORRIDOR #2
105 WASH BAY OFFICE	115 PLENUM #2	125 WOMEN'S LOCKER	135 IMIS/SERVER ROOM	145 DUST COLLECTION ROOM
106 WASH BAY EQUIP ROOM	116 SERVICE CORRIDOR #2	126 WOMEN'S TOILET	136 COMPOSITE REPAIR/ PREPARATION	
107 TRAINING DETACHMENT/ LABORATORY	117 COMPRESSOR ROOM	127 MEN'S LOCKERS	137 COMPOSITE REPAIR/ CURRING	
108 TRAINING ROOM	118 BOILER ROOM	128 MEN'S TOILET	138 TOOL ROOM	
109 COATINGS RESTORATION BAY	119 JANITOR'S CLOSET	129 BREAK ROOM	139 DIRTY AREA READY ROOM	
110 PLENUM #1	120 COMMUNICATIONS ROOM #2	130 ADMINISTRATION	140 ELECTRICAL ROOM #2	

SQUARE FOOTAGE	
PAINT BAY	5333 SQ. FT.
STAGING	3356 SQ. FT.
PAINT STORAGE	203 SQ. FT.
HAZ. STORAGE	195 SQ. FT.
LAUNDRY	123 SQ. FT.
JANITOR	58 SQ. FT.
OPEN OFFICE	233 SQ. FT.
WOMEN'S LOCKER	178 SQ. FT.
MEN'S LOCKER	178 SQ. FT.
UNISEX	52 SQ. FT.
ELECTRICAL	212 SQ. FT.
HEF ROOM	277 SQ. FT.
MECHANICAL	358 SQ. FT.
WALL/TRANSITION	2136 SQ. FT.
TOTAL	12892 SQ. FT.



DESIGNED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 1	OCT 2001	HACC023010	711-18-13	711-18-13
CHECKED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 2				
DESIGNED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 3				
CHECKED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 4				
DESIGNED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 5				
CHECKED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 6				
DESIGNED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 7				
CHECKED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 8				
DESIGNED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 9				
CHECKED BY	DATE	PROJECT NO.	OPERATION NO.	FILE NAME
NO. 10				

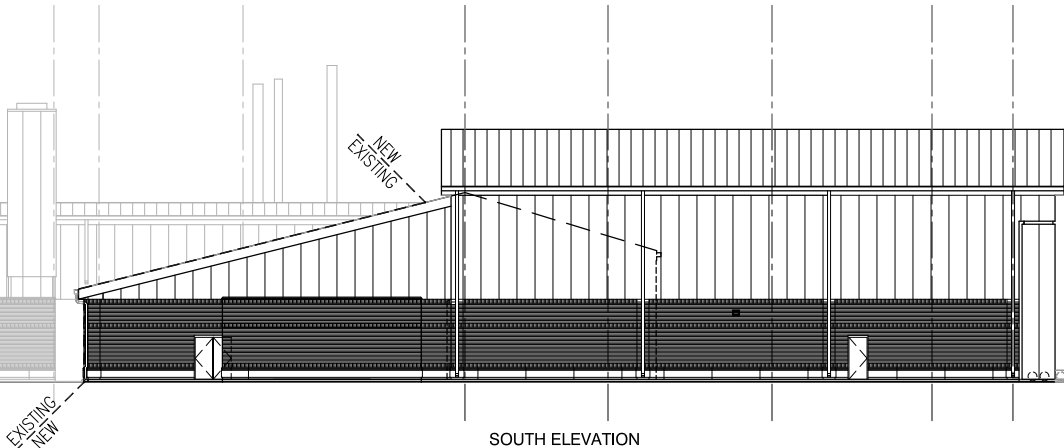
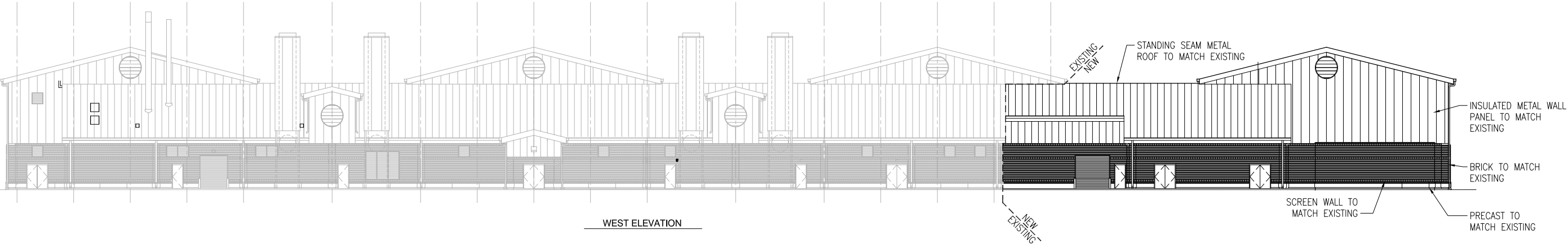
NORFOLK DISTRICT  
CORPS OF ENGINEERS  
NORFOLK, VIRGINIA

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F-22 OPERATIONS AND MAINTENANCE  
FACILITIES  
LANGLEY AIR FORCE BASE, VIRGINIA  
LO/CR FACILITY  
PLAN CONCEPT 1  
SCHEME 5

SCHEME 5  
SHEET OF

## Section



US Army Corps  
of Engineers  
Norfolk District

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DATE:	OCT 2001
ORIGIN:	AS SHOWN
SCALE:	AS SHOWN
SUBMITTED:	NORFOLK DISTRICT FILE NO. LF-422-1.335
PROJECT NO.	HACC023010
DRAWING NO.	SPECIFICATION NO. 7711-18-13
LAST WORKED ON:	DACA65-01-R-0025
FILE NAME:	Plot scale: 1:1

NORFOLK DISTRICT  
CORPS OF ENGINEERS  
NORFOLK, VIRGINIA



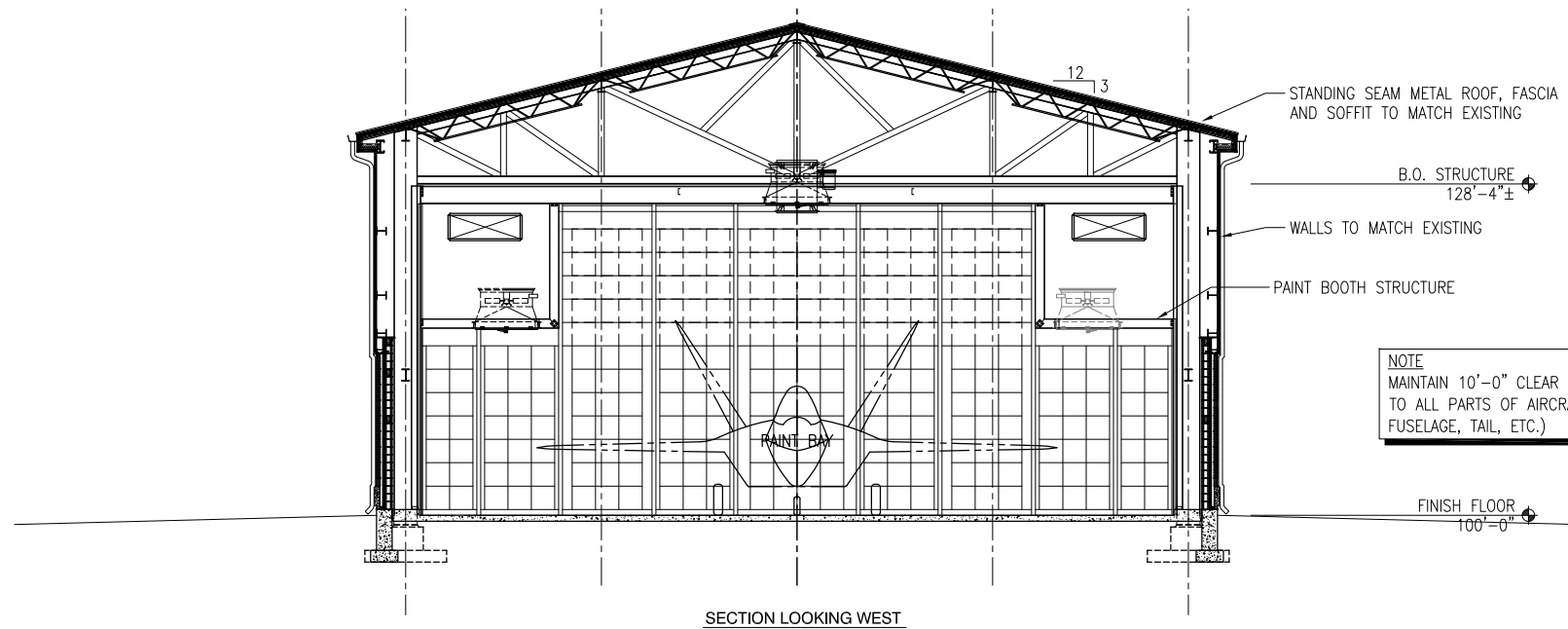
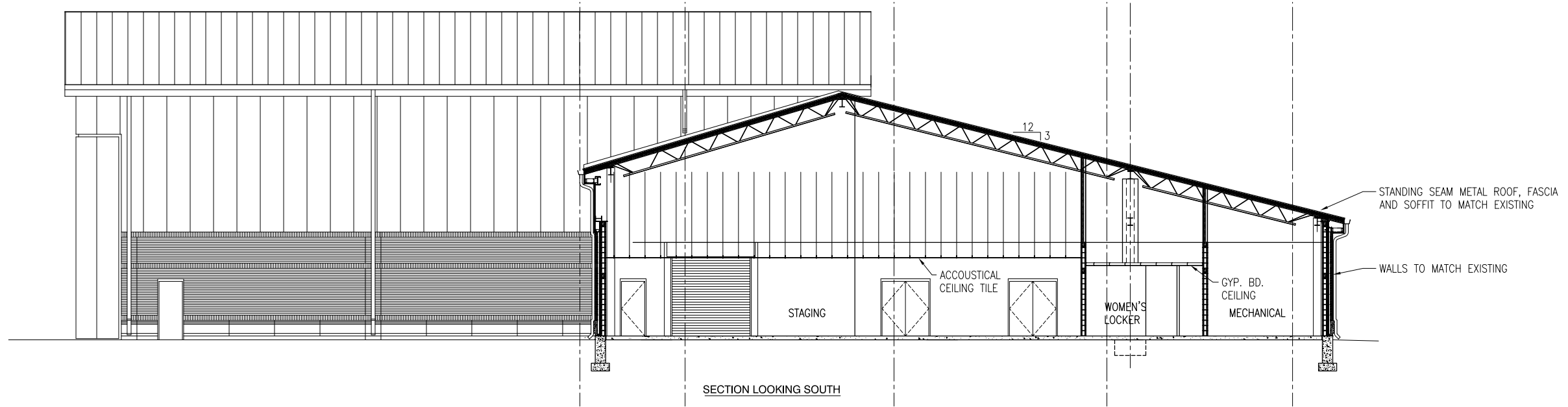
**F-22 OPERATIONS AND MAINTENANCE  
FACILITIES  
LANGLEY AIR FORCE BASE, VIRGINIA**

LO/CR FACILITY  
ELEVATION CONCEPT 1  
SCHEME 5

ELEVATIONS

SHEET      OF

## Section:



US Army Corps  
of Engineers  
Norfolk District

[illegible]

FILE NO.	711-18-13	PROJECT NO.	HACC023010	SUBMITTED:	AS SHOWN	SCALE:	AS SHOWN
DRAWING NO.	711-18-13	PROJECT NO.	HACC023010	SUBMITTED:	AS SHOWN	SCALE:	AS SHOWN
LAST REVISED ON:		PROJECT NO.	HACC023010	SUBMITTED:	AS SHOWN	SCALE:	AS SHOWN
FILE NAME:		PROJECT NO.	HACC023010	SUBMITTED:	AS SHOWN	SCALE:	AS SHOWN

NORFOLK DISTRICT  
CORPS OF ENGINEERS  
NORFOLK, VIRGINIA

LANGLEY AIR FORCE BASE, VIRGINIA  
FACILITIES  
LO/CR FACILITY  
SECTIONS CONCEPT 1  
LAYOUT 4

E5

SHEET OF

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX K

### Utility Cost Information

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

Current utility rates for Langley AFB

Electricity	\$0.0697/kwh blended
Natural Gas	\$8.323/kcf
Water	\$4.164/kgal
Wastewater	\$3.369/kgal

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX L

### LEED 2009 Project Credit Guidance



Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Project Name: F-22 ADD/ALTER Hangar Bay LO/CR FACILITY

**LEED 2009 Project Credit Guidance**

Date: 4/30/10

This spreadsheet indicates Air Force required credits, Air Force preferred credits, project-specific ranking of individual point preferences, assumptions guidance for individual credits, and references to related language in the RFP for individual credits.

**Air Force Guidance:** Rqd=Required, Pref=Preferred,

**Project Preference Ranking:** 1=Most Preferred, 3=Least Preferred, Blank=No Preference, X=Preference Not Applicable to This Project, Rqd=Required

Air Force Guidance	Project Preference Ranking	Credit	Credit Description	Remarks
<b>Sustainable Sites</b>				
Rqd	Rqd	Prereq 1	Construction Activity Pollution Prevention	Requirements of Design-Build Team to meet NPDES or State/Local requirements. All LEED prerequisites are required to be met.
	1	Credit 1	Site Selection	Project site meets criteria for this credit. See paragraph 6.14.5, LEED CREDITS COORDINATION.
	X	Credit 2	Development Density and Community Connectivity	Residential zone does not meet credit requirements for density and location. See paragraph 6.14.5, LEED CREDITS COORDINATION.
	X	Credit 3	Brownfield Development	Building criteria at this time does not indicate this site meets credit requirements. See paragraph 6.14.5, LEED CREDITS COORDINATION.
	X	Credit 4.1	Alternative Transportation - Public Transportation Access	Site does not meet criteria for Public Transportation Access. See paragraph 6.14.5, LEED CREDITS COORDINATION.
Pref	1	Credit 4.2	Alternative Transportation - Bicycle Storage and Changing Rooms	Changing rooms and bike racks shall be included in project.
	X	Credit 4.3	Alternative Transportation - Low-Emitting and Fuel-Efficient Vehicles	No new parking on site. This credit does not apply.
Pref	1	Credit 4.4	Alternative Transportation - Parking Capacity	No new parking on site. Meets credit intent.
	2	Credit 5.1	Site Development - Protect or Restore Habitat	Design-Build firm responsible for setting LEED site boundary. This will determine if credit is achievable.
Pref	2	Credit 5.2	Site Development - Maximize Open Space	Design-Build firm responsible for setting LEED site boundary. This will determine if credit is achievable.
Rqd	1	Credit 6.1	Stormwater Design - Quantity Control	Project must meet requirements of this credit. See paragraph 5.1.2.6, STORMWATER MANAGEMENT
Rqd	1	Credit 6.2	Stormwater Design - Quality Control	Project must meet requirements of this credit. See paragraph 5.1.2.6, STORMWATER MANAGEMENT
	2	Credit 7.1	Heat Island Effect - Non-roof	Design-Build firm to determine if 50% of hardscape can qualify for this credit requirement. Use of high SRI concrete on paved surfaces can contribute to this credit.

Rqd	1	Credit 7.2	Heat Island - Roof	Roof systems shall be provided with an SRI of 29 minimum for 75% of roof. Match Dark Bronze standing seam roof color. Note: Dark Bronze is available with SRI of 29 or greater by certain manufacturers.
Pref	1	Credit 8	Light Pollution Reduction	Design-Build firm to provide lighting design and calculations to determine if credit is achievable.

**Water Efficiency**

Rqd	Rqd	Prereq 1	Water Use Reduction - 20% Reduction	All LEED prerequisites are required to be met. See paragraph 5.6.8, BUILDING WATER USE REDUCTION.
Rqd	1	Credit 1	Water Efficient Landscaping Reduce by 50% No Potable Water Use or Irrigation	No potable water use for irrigation - required. See paragraph IRRIGATION. Project must include landscaping to be eligible for this credit.
	3	Credit 2	Innovative Wastewater Technologies	Design-Build firm to address any potential for Innovative Wastewater Technologies - rainwater capture or other options?
Pref	1	Credit 3	Water Use Reduction Reduce by 30% Reduce by 35% Reduce by 40%	Preliminary calculations based on RFP floor plan, low-flow fixtures and 70% Male/30% Female ratio will provide 40% reduction from baseline. See paragraph 5.6.8, BUILDING WATER USE REDUCTION

**Energy and Atmosphere**

Rqd	Rqd	Prereq 1	Fundamental Commissioning of Building Energy Systems	All LEED prerequisites are required to be met. See paragraph 5.8.5, COMMISSIONING.
Rqd	Rqd	Prereq 2	Minimum Energy Performance	All LEED prerequisites are required to be met.
Rqd	Rqd	Prereq 3	Fundamental Refrigerant Management	All LEED prerequisites are required to be met.
Rqd	1	Credit 1	Optimize Energy Performance Improve by 12% to 48% for New Buildings or 8% to 44% for Existing Buildings	Earning of LEED EA1 points as indicated in paragraph 5.9, ENERGY CONSERVATION, as a minimum is required.
Pref	1	Credit 2	On-Site Renewable Energy 1% to 13% Renewable Energy	See paragraph 5.9, ENERGY CONSERVATION.
Pref	1	Credit 3	Enhanced Commissioning	Enhanced Commissioning shall be provided as an Option. See paragraph 6.14.8.3.2, (OPTION #3) ENHANCED COMMISSIONING.
Rqd	1	Credit 4	Enhanced Refrigerant Management	Design-Build firm to provide equipment that meets intent of credit.
	2	Credit 5	Measurement and Verification	Installation shall meet EPA requirements for metering. M&V metering and verification requirements are in excess of EPA requirements. M&V shall be provided as an Option. See paragraph 6.14.8.4, (OPTION #4) MEASUREMENT AND VERIFICATION.
	3	Credit 6	Green Power	Credit is determined by Installation's purchase of green power. Confirm purchase of renewable energy credits (REC's) is available through local utility or REC provider. See paragraph 6.14.5, LEED CREDITS COORDINATION.

**Materials and Resources**

Rqd	Rqd	Prereq 1	Storage and Collection of Recyclables	All LEED prerequisites are required to be met. Coordinate with Installation during design development on collection service, general recycle storage area and receptacles.
		Credit 1.1	Building Reuse - Maintain Existing Walls, Floors and Roof	Not applicable. LEED boundary will be between existing and new structure.
			Reuse 55%	
			Reuse 75%	
	X		Reuse 95%	
	X	Credit 1.2	Building Reuse - Maintain 50% of Interior Non-Structural Elements	Not applicable. LEED boundary will be between existing and new structure.
Rqd	1	Credit 2	Construction Waste Management	See paragraph 5.12, CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT. 50% Recycled is required.
			50% Recycled or Salvaged	
			75% Recycled or Salvaged	
		Credit 3	Material Reuse	Not applicable. LEED boundary will be between existing and new structure.
	X		Reuse 5%	
			Reuse 10%	
Rqd	1	Credit 4	Recycled Content	See paragraph 5.11.8, RECYCLED CONTENT. 10% recycled content is required.
			10% (Post-consumer + 1/2 Pre-Consumer)	
			20% (Post-consumer + 1/2 Pre-Consumer)	
Pref	1	Credit 5	Regional Materials	Design-Build firm to determine attainability of these credits. Project site is centrally located to a number of harvest/manufacturing facilities (500 mile radius).
			10% Extracted, Processed & Manufactured Regionally	
			20% Extracted, Processed & Manufactured Regionally	
Rqd	3	Credit 6	Rapidly Renewable Materials	Potential amount of rapidly renewable materials may not meet minimum requirements for this building type. See paragraph 5.11.9, BIOBASED AND ENVIRONMENTALLY PREFERABLE MATERIALS, and paragraph 5.11.10, FEDERAL BIOBASED PRODUCTS PREFERRED PROCUREMENT PROGRAM.
Rqd	1	Credit 7	Certified Wood	Minimal amount of wood should make this credit achievable. See paragraph 5.11.9, BIOBASED AND ENVIRONMENTALLY PREFERABLE MATERIALS.

**Indoor Environmental Quality**

Rqd	Rqd	Prereq 1	Minimum Indoor Air Quality Performance	All LEED prerequisites are required to be met.
Rqd	Rqd	Prereq 2	Environmental Tobacco Smoke (ETS) Control	All LEED prerequisites are required to be met. Assume all buildings are smoke free unless indicated otherwise.
Pref	1	Credit 1	Outdoor Air Delivery Monitoring	Design-Build firm to integrate CO2 monitoring requirements into design.
	2	Credit 2	Increased Ventilation	This credit may be achievable depending on final design.
Rqd	1	Credit 3.1	Construction IAQ Management Plan - During Construction	See paragraph 5.11.7, CONSTRUCTION IAQ MANAGEMENT.
Rqd	1	Credit 3.2	Construction IAQ Management Plan - Before Occupancy	See paragraph 5.11.7, CONSTRUCTION IAQ MANAGEMENT.
Rqd	1	Credit 4.1	Low-Emitting Materials - Adhesives and Sealants	See paragraph 5.11.6, LOW-EMITTING MATERIALS.

Rqd	1	Credit 4.2	Low-Emitting Materials - Paints and Coatings	See paragraph 5.11.6, LOW-EMITTING MATERIALS.
Rqd	1	Credit 4.3	Low-Emitting Materials - Flooring Systems	See paragraph 5.11.6, LOW-EMITTING MATERIALS.
Rqd	1	Credit 4.4	Low-Emitting Materials - Composite Wood and Agrifiber Products	See paragraph 5.11.6, LOW-EMITTING MATERIALS.
Pref	2	Credit 5	Indoor Chemical and Pollutant Source Control	Design-Build firm to determine if all criteria for credit can be achieved.
Pref	1	Credit 6.1	Controllability of Systems - Lighting	Design-Build firm to incorporate lighting controllability into CD's.
	2	Credit 6.2	Controllability of Systems - Thermal Comfort	Design-Build firm to determine if credit is achievable.
Rqd	1	Credit 7.1	Thermal Comfort - Design	Design-Build firm to determine if credit is achievable.
	X	Credit 7.2	Thermal Comfort - Verification	Project must earn credit EQ7.1 to be eligible for this credit. Assume Government will not provide post-occupancy activities unless indicated otherwise.
Rqd	X	Credit 8.1	Daylight and Views - Daylight	Project type cannot achieve this credit.
	X	Credit 8.2	Daylight and Views - Views	Project type cannot achieve this credit.

**Innovation and Design Process**

Pref	1	Credit 1.1	Innovation in Design: Specific Title	Design-Build firm to evaluate potential for exemplary performance credits and ID credits for Federal agency requirements.
Pref	1	Credit 1.2	Innovation in Design: Specific Title	
Pref	1	Credit 1.3	Innovation in Design: Specific Title	
Pref	2	Credit 1.4	Innovation in Design: Specific Title	
Pref	2	Credit 1.5	Innovation in Design: Specific Title	
Rqd	1	Credit 2	LEED Accredited Professional	LEED AP during design and construction is required.

**Regional Priority Credits**

Pref	1	Credit 1.1	Regional Priority: SScr 1 - Site Selection	Project site meets criteria for this credit. See paragraph 6.14.5, LEED CREDITS COORDINATION.
Rqd	1	Credit 1.2	Regional Priority: SScr 6.1 Stormwater Design	Project must meet requirements of this credit. See paragraph 5.1.2.6, STORMWATER MANAGEMENT
Rqd	1	Credit 1.3	Regional Priority: SScr 6.2 Stormwater Design	Project must meet requirements of this credit. See paragraph 5.1.2.6, STORMWATER MANAGEMENT
Pref	1	Credit 1.4	Regional Priority: Wscr 3 Water Use Reduction - 40% Reduction	Preliminary calculations based on RFP floor plan, low-flow fixtures and 70% Male/30% Female ratio will provide 40% reduction from baseline. See paragraph 5.6.8, BUILDING WATER USE REDUCTION

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX M

### LEED Owner's Project Requirements

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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13 April 10

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# Owner's Project Requirements Document for LEED Fundamental Commissioning

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Project: F-22 Add/ Alter Hangar Bay LO/CR Facility

Approved:

\_\_\_\_\_  
Name\_\_\_\_\_  
Owner's Representative\_\_\_\_\_  
Date\_\_\_\_\_  
Name\_\_\_\_\_  
Design Agent's Representative\_\_\_\_\_  
Date

---

## Overview and Instructions

The purpose of this document is to provide clear and concise documentation of the Owner's goals, expectations and requirements for commissioned systems, and shall be utilized throughout the project delivery and commissioning process to provide an informed baseline and focus for design development and for validating systems' energy and environmental performance.

The Owner's Project Requirements Document is a required document for LEED Version 2009 EA Prerequisite 1, Fundamental Commissioning of the Building Energy Systems. It shall be completed by the Corps District/Design Agent based on coordination with the Installation/User/Proponent and shall be approved by the Installation/User/Proponent representative.

Use of this template is not required, nor are there any restrictions on editing of it. It is provided simply as a tool to assist project teams in meeting the documentation requirements for LEED Fundamental Commissioning.

The intent of the Owner's Project Requirements Document, per the LEED v2009 Reference Guide, is to detail the functional requirements of a project and the expectations of the building's use and operation as it relates to commissioned systems. This template contains the basic recommended components indicated in the LEED v2009 Reference Guide. It should be adapted as needed to suit the project, remaining reflective of the LEED intent.

The Owner's Project Requirements Document should ideally be completed before the start of design and furnished to the design team. It must be completed prior to the approval of Contractor submittals of any commissioned equipment or systems to meet LEED requirements.



13 April 10

Updates to the Owner's Project Requirements Document throughout the course of project delivery shall be made by the Corps District/Design Agent based on decisions and agreements coordinated with and agreed to by the Installation/User/Proponent.

The Owner's Project Requirements Document shall be included in the project's LEED documentation file under EA PR1, Fundamental Commissioning of the Building Energy Systems.

13 April 10

## Owner's Project Requirements Document for LEED Fundamental Commissioning

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1. Owner and User Requirements
  - Primary Purpose, Program and Use
  - Project History
  - Broad Goals
2. Environmental and Sustainability Goals
  - Energy Efficiency Goals
  - General
  - Siting
  - Building Façade
  - Building Fenestration
  - Building Envelope
  - Roof
  - Other
3. Indoor Environmental Quality Requirements
  - Intended Use
  - Occupancy Schedule
  - Accommodations for After-Hours Use
  - Lighting, Temperature, Humidity, Air Quality, Ventilation, Filtration
  - Acoustics
  - Occupant Ability to Adjust System Controls
  - Types of Lighting
4. Equipment and Systems Expectations
  - Space Heating
  - Ventilation
  - Air Conditioning
  - Refrigeration
  - HVAC Controls
  - Domestic Hot Water
  - Lighting Controls
  - Daylighting Controls
  - Emergency Power
  - Other
5. Building Occupant and O&M Personnel Requirements
  - Facility Operation
  - EMCS
  - Occupant Training and Orientation
  - O&M Staff Training and Orientation

TABLE 1

13 April 10

## 1. **Owner and User Requirements**

What is the primary purpose, program and use of this project? (example: office building with data center)  
*The primary purpose of the project is a Paint Spray Hangar addition to an existing F-22 hangar facility, including support spaces.*

Describe pertinent project history. (example: standard design development)  
*The CCD is completed. The 1391 is completed. RFP for Design-Build delivery is in progress.*

### **Broad Goals**

What are the broad goals relative to program needs?  
*The program is intended to meet future capacity and demand for F-22 maintenance.*

What are the broad goals relative to future expansion?  
*Future expansion of the facility is unlikely due to site constraints. This does not include expansion of the facility with separate structures to the north or south ends of the facility.*

What are the broad goals relative to flexibility?  
*The use is specific to the function of spray painting F-22's.*

What are the broad goals relative to quality of materials?  
*Facility is to be designed for a 25 year useful design life.*

What are the broad goals relative to construction costs?  
*Construct a useable expansion meeting the functional needs and useful life within a budget of \$7.04 million.*

What are the broad goals relative to operational costs?  
*Design a facility to support efficient personnel and aircraft movements and minimal energy usage of the paint spray hangar.*

What are the broad goals relative to life cycle of the equipment?  
*Provide high quality equipment to minimize life cycle cost and maximize efficiency.*

Other broad goals: *(Insert as applicable)*  
*Architectural theme of the existing building is to be carried through the new facility. Match colors, textures and materials of the existing facility.*  
*Use the design of the paint spray hangar as a lessons learned example for improving the performance of the existing spray paint bays.*

## 2. **Environmental and Sustainability Goals**

What are the project goals relative to sustainability and environmental issues? (example: LEED Silver rating)  
*The project shall meet LEED version 3 Silver rating as a minimum.*  
*LEED Gold is a preference.*

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What are the project goals relative to energy efficiency? (example: Meet EPACT)

*Provide a minimum of 80% re-circulated air for paint spray hangar. Meet EPAct. Meet ASHRAE 90.1 standards. Provide high efficiency mechanical and electrical systems. ESA 2007, DODI 4170 \_ Geothermal systems are a consideration.*

What are the project goals and requirements for building siting that will impact energy use?

*Building is to adjoin existing spray paint hangars.*

What are the project goals and requirements for building facade that will impact energy use?

*Provide an energy efficient wall and roof system that matches the appearance of the existing facility.*

What are the project goals and requirements for building fenestration that will impact energy use?

*Not applicable. No windows.*

What are the project goals and requirements for building envelope that will impact energy use?

*Providing a photo-voltaic system on the south slope of the hangar bay may be an option if it does not conflict with the existing dark bronze roof color or cause reflection issues for aircraft.*

What are the project goals and requirements for building roof that will impact energy use?

*Provide a roof with a minimum SRI of 29 while matching existing dark bronze roof color.*

Other: *(Insert as applicable)*

*Achieve water conservation by eliminating landscape irrigation.*

### **3. Indoor Environmental Quality Requirements**

What is the intended use for all spaces? For all spaces that have an intended use that is not readily apparent from the space name, provide this information in Table 1.

*Refer to Appendix LL of the RFP.*

What is the anticipated occupancy schedule (numbers of occupants and time frames) for all occupied spaces? Indicate the default occupancy schedule below and for all spaces that have an occupancy schedule that differs from the default, provide this information in Table 1.

*Occupancy schedule will be 24/7 - total of 11 building occupants maximum in building addition, 40 hours per week, including 2 shifts at 7 occupants, 1 shift (day shift) at 11 occupants. Visitor count to be determined.*

What accommodations for after-hours use are required? (example: access control, lighting controls, HVAC controls) Indicate general accommodations required below and for all spaces that have special requirements, provide this information in Table 1.

*Not applicable. Building is open 24/7.*

What are the lighting, temperature, humidity, air quality, ventilation and filtration requirements for all spaces? Indicate the default requirements below and for all spaces that have a requirement that differs from the default, provide this information in Table 1.

*Refer to Table 1.*

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What are the acoustical requirements for all spaces? Indicate the default acoustical requirements below and for all spaces that have a requirement that differs from the default, provide this information in Table 1.

*Provide white noise in secured areas.*

What is the desired level of occupant ability to adjust systems controls? Indicate the default desired levels below and for all spaces that have a desired level that differs from the default, provide this information in Table 1.

*Lighting: Occupancy sensors and multi-level switching connected to the building operation system.*

*Temperature: Space thermostats in Administration and support areas.*

*Humidity: Process control for paint spray.*

*Air Quality: Per ASHRAE Standard 62.1 for Administration and support areas.*

*Ventilation: Per ASHRAE Standard 62.1 for Administration and support areas.*

What, if any, specific types of lighting are desired? (example: fluorescent in 2x2 grid, accent lighting, particular lamps)

*Paint spray hangar and paint storage and hazardous storage areas needs explosion-proof fixtures.*

*Admin and support areas get 2x4 grid. T8 or T5 lamps, 4100K, 82CRI or higher, induction lighting or T5 HO in the hangar bay.*

#### **4. Equipment and System Expectations**

*(Complete for each category as applicable or indicate "none identified" or "N/A". Add desired features information for other anticipated commissioned systems as applicable)*

Indicate desired features for the following commissioned system: Space Heating

Desired Type: *Hot water, gas fired, geothermal heat pump.*

Quality: *High*

Preferred Manufacturer: *Trane*

Reliability: *High*

Automation: *DDC connect to existing base-wide*

Flexibility: *Desired*

Maintenance Requirements: *Access to all required items – provide platforms as required*

Efficiency Target: *90% + boilers, comply with all energy standards*

Desired Technologies: *Direct vent boilers, geothermal heat pumps for Admin and Support areas*

Indicate desired features for the following commissioned system: Ventilation

Desired Type: *Supply air systems with economizer*

Quality: *High*

Preferred Manufacturer: *Trane*

Reliability: *High*

Automation: *DDC*

Flexibility: *Desired*

Maintenance Requirements: *Access to all equipment*

Efficiency Target: *Per ASHRAE standards and other requirements*

Desired Technologies: *Heat recovery for OA*

13 April 10

Indicate desired features for the following commissioned system: Air Conditioning

Desired Type: *Supply air system, geothermal heat pump*

Quality: *High*

Preferred Manufacturer: *Trane*

Reliability: *High*

Automation: *DDC*

Flexibility: *Desired*

Maintenance Requirements: *Access to all items, filters, etc.*

Efficiency Target: *Per ASHRAE standards - exceed ASHRAE where possible*

Desired Technologies: *Geothermal*

Indicate desired features for the following commissioned system: Refrigeration

Desired Type: *Air-cooled, heat pump*

Quality: *High*

Preferred Manufacturer: *Trane*

Reliability: *High*

Automation: *DDC*

Flexibility: *Desired for part loads*

Maintenance Requirements: *Access to equipment*

Efficiency Target: *Exceed ASHRAE KW/ton required*

Desired Technologies:

Indicate desired features for the following commissioned system: HVAC Controls

Desired Type: *Siemens DDC APOGEE protocol*

Quality: *High*

Preferred Manufacturer: *Siemens*

Reliability: *High*

Automation: *DDC*

Flexibility: *Desired*

Maintenance Requirements

Efficiency Target: *NA*

Desired Technologies: *Metering of new facility*

Indicate desired features for the following commissioned system: Domestic Hot Water

Desired Type: *Connect to existing domestic hot water system.*

Quality:

Preferred Manufacturer:

Reliability:

Automation:

Flexibility:

Maintenance Requirements:

Efficiency Target:

Desired Technologies:

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Indicate desired features for the following commissioned system: Lighting Controls

Desired Type: *Occupancy sensors, dual level, low voltage Hangar lighting controls*

Quality: *Extremely high*

Preferred Manufacturer: *Hubbell*

Reliability: *Very long life*

Automation: *Connected to EMCS with occupant override*

Flexibility: *NA*

Maintenance Requirements: *Easy lamp replacement from inside the paint booth*

Efficiency Target: *ASHRAE 90.1, UFC 3-530-01*

Desired Technologies: *Fluorescent, T5HO, induction, Siemens APPOGEE*

Indicate desired features for the following commissioned system: Daylighting Controls

Desired Type: *None – there are no windows.*

Quality:

Preferred Manufacturer:

Reliability:

Automation:

Flexibility:

Maintenance Requirements:

Efficiency Target:

Desired Technologies:

Indicate desired features for the following commissioned system: Emergency Power

Desired Type: *Battery pack ballasts for lighting and exit signs with self diagnostics*

Quality: *5 year warranty*

Preferred Manufacturer: *Bodine*

Reliability:

Automation:

Flexibility:

Maintenance Requirements:

Efficiency Target:

Desired Technologies:

Indicate desired features for the following commissioned system: Other – Paint spray bay heating

Desired Type: *80%/20% Recirculation*

Quality: *High*

Preferred Manufacturer: *GFS*

Reliability: *High*

Automation: *Industrial PLC*

Flexibility: *5 operating modes*

Maintenance Requirements: *Access to all equipment – maintenance platforms*

Efficiency Target: *40% energy reduction from existing bays*

Desired Technologies: *4 stage filtration*

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**5. Building Occupant and O&M Personnel Requirements**

Will the facility be connected to an EMCS? If so, what are the interface requirements? (example: monitoring points, control points, scheduling)

*Yes – will be connected to existing EMCS – Siemens APOGEE. Integrated to the base-wide EMCS system.*

What is the desired level of training and orientation for building occupants to understand and use the building systems?

*Provide high level of training and orientation for building occupants to fully understand the operation and maintenance of building systems. Separate user groups for operation and maintenance. Training materials shall be provided.*

What is the desired level of training and orientation for O&M staff to understand and maintain the building systems?

*See above.*



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*Table 1*

Space	Use / Activity	Num of Occs	Special Occupancy Schedule	After Hours Use Reqmt.	Special Cooling Reqmt.	Special Heating Reqmt.	Special Humidity Reqmt.	Special Ventil./Filtration Reqmt.	Special Acoustic Reqmt.	Special Lighting Reqmt.	Special Occup Adjustability Reqmt.
Paint Hangar	Spray paint of F-22		N/A	N/A	N/A	70-75 °	NSR	NSR	White Noise	Explosion-Proof	
Staging Area			N/A	N/A	NSR	NSR	NSR	NSR	White Noise	NSR	
Hazardous Storage			N/A	N/A	NSR	NSR	NSR	NSR	NSR	Explosion-Proof	
Paint Storage			N/A	N/A	NSR	NSR	NSR	NSR	NSR	Explosion-Proof	
Women's Locker Room			N/A	N/A	NSR	NSR	NSR	NSR	White Noise	NSR	
Men's Locker Room			N/A	N/A	NSR	NSR	NSR	NSR	White Noise	NSR	
Laundry			N/A	N/A	NSR	NSR	NSR	NSR	NSR	NSR	
Open Office			N/A	N/A	NSR	NSR	NSR	NSR	White Noise	NSR	
Janitor			N/A	N/A	NSR	NSR	NSR	NSR	NSR	NSR	
Electrical Room			N/A	N/A	N/A	NSR	NSR	NSR	NSR	NSR	

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HEF Room	Fire protection foam tank		N/A	N/A	N/A	NSR	NSR	NSR	NSR	NSR	
Mechanical Room			N/A	N/A	N/A	NSR	NSR	NSR	NSR	NSR	
Unisex Toilet			N/A	N/A	NSR	NSR	NSR	NSR	NSR	NSR	

NSR – No special requirements.

N/A – Not applicable.

Add/Alter Hangar Bay  
LO/CR Facility  
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Add/Alter Hangar Bay  
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Langley AFB, Virginia

Section: APPENDIX N

(Not Supplied)

## APPENDIX N

### LEED Requirements for Multiple Contractor Combined Projects

Not Used

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Langley AFB, Virginia

## APPENDIX O

### LEED Strategy Tables

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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## LEED 2009 for New Construction and Major Renovation

## Project Checklist

Project Name F-22 ADD/ ALTER HANGAR BAY LO/CR FACILITY

Date 04/30/2010

7	15	4	<b>Sustainable Sites</b>	Possible Points: 26
---	----	---	--------------------------	---------------------

Y	N	?			
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
	5		Credit 2	Development Density and Community Connectivity	5
	1		Credit 3	Brownfield Redevelopment	1
	6		Credit 4.1	Alternative Transportation—Public Transportation Access	6
	1		Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
	3		Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
	2		Credit 4.4	Alternative Transportation—Parking Capacity	2
		1	Credit 5.1	Site Development—Protect or Restore Habitat	1
		1	Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
1			Credit 6.2	Stormwater Design—Quality Control	1
		1	Credit 7.1	Heat Island Effect—Non-roof	1
1			Credit 7.2	Heat Island Effect—Roof	1
		1	Credit 8	Light Pollution Reduction	1

8		2	<b>Water Efficiency</b>	Possible Points: 10
---	--	---	-------------------------	---------------------

Y	N	?			
Y			Prereq 1	Water Use Reduction—20% Reduction	
4			Credit 1	Water Efficient Landscaping	2 to 4
		2	Credit 2	Innovative Wastewater Technologies	2
4			Credit 3	Water Use Reduction	2 to 4

7	13	15	<b>Energy and Atmosphere</b>	Possible Points: 35
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Y	N	?			
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
5	8	6	Credit 1	Optimize Energy Performance	1 to 19
	5	2	Credit 2	On-Site Renewable Energy	1 to 7
		2	Credit 3	Enhanced Commissioning	2
2			Credit 4	Enhanced Refrigerant Management	2
		3	Credit 5	Measurement and Verification	3
		2	Credit 6	Green Power	2

7	7		<b>Materials and Resources</b>	Possible Points: 14
---	---	--	--------------------------------	---------------------

Y	N	?			
Y			Prereq 1	Storage and Collection of Recyclables	
	3		Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
	1		Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
2			Credit 2	Construction Waste Management	1 to 2
	2		Credit 3	Materials Reuse	1 to 2

<b>Materials and Resources, Continued</b>				
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Y	N	?			
2			Credit 4	Recycled Content	1 to 2
2			Credit 5	Regional Materials	1 to 2
	1		Credit 6	Rapidly Renewable Materials	1
1			Credit 7	Certified Wood	1

7	3	5	<b>Indoor Environmental Quality</b>	Possible Points: 15
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Y	N	?			
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
1			Credit 1	Outdoor Air Delivery Monitoring	1
		1	Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
		1	Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
1			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
		1	Credit 5	Indoor Chemical and Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems—Lighting	1
		1	Credit 6.2	Controllability of Systems—Thermal Comfort	1
		1	Credit 7.1	Thermal Comfort—Design	1
		1	Credit 7.2	Thermal Comfort—Verification	1
	1		Credit 8.1	Daylight and Views—Daylight	1
	1		Credit 8.2	Daylight and Views—Views	1

1		5	<b>Innovation and Design Process</b>	Possible Points: 6
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		1	Credit 1.1	Innovation in Design: Specific Title	1
		1	Credit 1.2	Innovation in Design: Specific Title	1
		1	Credit 1.3	Innovation in Design: Specific Title	1
		1	Credit 1.4	Innovation in Design: Specific Title	1
		1	Credit 1.5	Innovation in Design: Specific Title	1
1			Credit 2	LEED Accredited Professional	1

3		1	<b>Regional Priority Credits</b>	Possible Points: 4
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1			Credit 1.1	Regional Priority: SScr 1 Site Selection	1
1			Credit 1.2	Regional Priority: SScr 6.1 or 6.2 Stormwater Design	1
1			Credit 1.3	Regional Priority: SScr 6.1 or 6.2 Stormwater Design	1
		1	Credit 1.4	Regional Priority: WEcr 3 Water Use Reduction - 40%	1

40	38	32	<b>Total</b>	Possible Points: 110
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Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

Tuesday, July 13, 2010





## LEED 2009 for New Construction and Major Renovation

### Project Checklist

Project Name F-22 ADD/ ALTER HANGAR BAY LO/CR FACILITY

Date 04/30/2010

7	15	4	<b>Sustainable Sites</b>		Possible Points: 26
Y	N	?			
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
	5		Credit 2	Development Density and Community Connectivity	5
	1		Credit 3	Brownfield Redevelopment	1
	6		Credit 4.1	Alternative Transportation—Public Transportation Access	6
1			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
	3		Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	Alternative Transportation—Parking Capacity	2
		1	Credit 5.1	Site Development—Protect or Restore Habitat	1
		1	Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
1			Credit 6.2	Stormwater Design—Quality Control	1
		1	Credit 7.1	Heat Island Effect—Non-roof	1
1			Credit 7.2	Heat Island Effect—Roof	1
		1	Credit 8	Light Pollution Reduction	1

8	0	2	<b>Water Efficiency</b>		Possible Points: 10
Y			Prereq 1	Water Use Reduction—20% Reduction	
4			Credit 1	Water Efficient Landscaping	2 to 4
				Reduce by 50%	2
				4 No Potable Water Use or Irrigation	4
		2	Credit 2	Innovative Wastewater Technologies	2
4			Credit 3	Water Use Reduction	2 to 4
				Reduce by 30%	2
				Reduce by 35%	3
				4 Reduce by 40%	4

7	13	15	Energy and Atmosphere		Possible Points:	35
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems		
Y			Prereq 2	Minimum Energy Performance		
Y			Prereq 3	Fundamental Refrigerant Management		
5	8	6	Credit 1	Optimize Energy Performance	1 to 19	
				Improve by 12% for New Buildings or 8% for Existing Building Renovations	1	
				Improve by 14% for New Buildings or 10% for Existing Building Renovations	2	
				Improve by 16% for New Buildings or 12% for Existing Building Renovations	3	
				Improve by 18% for New Buildings or 14% for Existing Building Renovations	4	
			5	Improve by 20% for New Buildings or 16% for Existing Building Renovations	5	
				Improve by 22% for New Buildings or 18% for Existing Building Renovations	6	
				Improve by 24% for New Buildings or 20% for Existing Building Renovations	7	
				Improve by 26% for New Buildings or 22% for Existing Building Renovations	8	
				Improve by 28% for New Buildings or 24% for Existing Building Renovations	9	
				Improve by 30% for New Buildings or 26% for Existing Building Renovations	10	
				Improve by 32% for New Buildings or 28% for Existing Building Renovations	11	
				Improve by 34% for New Buildings or 30% for Existing Building Renovations	12	
				Improve by 36% for New Buildings or 32% for Existing Building Renovations	13	
				Improve by 38% for New Buildings or 34% for Existing Building Renovations	14	
				Improve by 40% for New Buildings or 36% for Existing Building Renovations	15	
				Improve by 42% for New Buildings or 38% for Existing Building Renovations	16	
				Improve by 44% for New Buildings or 40% for Existing Building Renovations	17	
				Improve by 46% for New Buildings or 42% for Existing Building Renovations	18	
				Improve by 48%+ for New Buildings or 44%+ for Existing Building Renovations	19	
	5	2	Credit 2	On-Site Renewable Energy	1 to 7	
				1% Renewable Energy	1	
				3% Renewable Energy	2	
				5% Renewable Energy	3	
				7% Renewable Energy	4	
				9% Renewable Energy	5	
				11% Renewable Energy	6	
				13% Renewable Energy	7	
		2	Credit 3	Enhanced Commissioning	2	
2			Credit 4	Enhanced Refrigerant Management	2	
		3	Credit 5	Measurement and Verification	3	
		2	Credit 6	Green Power	2	

7	7	0	<b>Materials and Resources</b>	Possible Points: 14
---	---	---	--------------------------------	---------------------

Y			Prereq 1	Storage and Collection of Recyclables	
	3		Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
				Reuse 55%	1
				Reuse 75%	2
				Reuse 95%	3
	1		Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
2			Credit 2	Construction Waste Management	1 to 2
				50% Recycled or Salvaged	1
				75% Recycled or Salvaged	2
	2		Credit 3	Materials Reuse	1 to 2
				Reuse 5%	1
				Reuse 10%	2
2			Credit 4	Recycled Content	1 to 2
				10% of Content	1
				20% of Content	2
2			Credit 5	Regional Materials	1 to 2
				10% of Materials	1
				20% of Materials	2
	1		Credit 6	Rapidly Renewable Materials	1
1			Credit 7	Certified Wood	1

7	3	5	<b>Indoor Environmental Quality</b>	Possible Points: 15
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Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
1			Credit 1	Outdoor Air Delivery Monitoring	1
		1	Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
		1	Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
1			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
		1	Credit 5	Indoor Chemical and Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems—Lighting	1
		1	Credit 6.2	Controllability of Systems—Thermal Comfort	1
		1	Credit 7.1	Thermal Comfort—Design	1
	1		Credit 7.2	Thermal Comfort—Verification	1
	1		Credit 8.1	Daylight and Views—Daylight	1
	1		Credit 8.2	Daylight and Views—Views	1

1	0	5	<b>Innovation and Design Process</b>	<b>Possible Points: 6</b>
		1	Credit 1.1 Innovation in Design: Specific Title	1
		1	Credit 1.2 Innovation in Design: Specific Title	1
		1	Credit 1.3 Innovation in Design: Specific Title	1
		1	Credit 1.4 Innovation in Design: Specific Title	1
		1	Credit 1.5 Innovation in Design: Specific Title	1
1			Credit 2 LEED Accredited Professional	1
3	0	1	<b>Regional Priority Credits</b>	<b>Possible Points: 4</b>
1			Credit 1.1 Regional Priority: SScr 1 Site Selection	1
1			Credit 1.2 Regional Priority: SScr 6.1 or 6.2 Stormwater Design	1
1			Credit 1.3 Regional Priority: SScr 6.1 or 6.2 Stormwater Design	1
		1	Credit 1.4 Regional Priority: WEcr 3 Water Use Reduction - 40%	1
40	38	32	<b>Total</b>	<b>Possible Points: 110</b>
Certified 40 to 49 points   Silver 50 to 59 points   Gold 60 to 79 points   Platinum 80 to 110				

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Add/Alter Hangar Bay  
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## APPENDIX P

### USGBC Registration of Air Force Projects

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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## F-22 Add/ Alter Hangar Bay LO/CR Facilit

Hampton VA 23665 US | Registered 3/2/2010

Setup Incomplete

Project ID 1000005061 | Access ID 705294231160758

Project Administrator: Thomas Warner

[Refresh](#)

## Project Setup: Project Information

The Registration Details tab allows you to review/edit information provided at registration. From the Contact info and Additional Contacts tabs you may provide contact details for the main contributors to the design and construction of this project.

[Registration Details](#) [Contact Info](#) [Additional Contact](#)Project Admin: **Thomas Warner**

At anytime you may select the following link to access and review the LEED Project Registration Agreement that you accepted prior to reregistering this Project: [Download File](#)

## Project Information

Title: \*

Address 1: \*

Address 2:

City: \*

State/US Territory/Canadian Province: \*

Country: \*

Zip code / Postal code: \*

Anticipated Construction Start Date: \*

Anticipated Construction End Date: \*

Gross project square footage: \*  *You may edit your gross square footage value in Plf2 (Project Summary Details)*

[Is Project Confidential?](#) Yes No

Would you like to receive national membership info? Yes No

## Project Owner Information

Select existing team member:

Salutation:

Name: \*

Address Line 1: \*

Address Line 2:

City: \*

State/US Territory/Canadian Province: \*

Country: \*

Zip code / Postal code: \*

Telephone: \*

Fax:

Organization: \*

Job Title:

Email: \*

USGBC national member: \* Yes No

Owner Type: \*

May we publish owner information: \* Yes No

I understand and agree that the Project Owner Assertion MUST be executed by the Project Owner before submission of the application for review of this Project.

Click here to view [LEED® Certification agreement between Green Building Certification Institute and Project Owner.](#)

[Update](#)

To save changes, please click on update before leaving the page.

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Tuesday, July 13, 2010



Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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**APPENDIX Q**  
**REV 1.1 – 31 MAY 2009**  
**AREA COMPUTATIONS**

**Computation of Areas:** Compute the "gross area" and "net area" of facilities (excluding family housing) in accordance with the following subparagraphs:

**(1) Enclosed Spaces:** The "gross area" is the sum of all floor spaces with an average clear height  $\geq 6'-11"$  (as measured to the underside of the structural system) and having perimeter walls which are  $\geq 4'-11"$ . The area is calculated by measuring to the exterior dimensions of surfaces and walls.

**(2) Half-Scope Spaces:** Areas of the following spaces shall count as one-half scope when calculating "gross area":

- Balconies
- Porches
- Covered exterior loading platforms or facilities
- Covered but not enclosed passageways and walks
- Open stairways (both covered and uncovered)
- Covered ramps
- Interior corridors (Unaccompanied Enlisted Personnel Housing Only)

**(3) Excluded Spaces:** The following spaces shall be excluded from the "gross area" calculation:

- Crawl spaces
- Uncovered exterior loading platforms or facilities
- Exterior insulation applied to existing buildings
- Open courtyards
- Open paved terraces
- Uncovered ramps
- Uncovered stoops
- Utility tunnels and raceways
- Roof overhangs and soffits measuring less than 3'-0" from the exterior face of the building to the fascia

**(4) Net Floor Area:** Where required, "net area" is calculated by measuring the inside clear dimensions from the finish surfaces of walls. If required, overall "assignable net area" is determined by subtracting the following spaces from the "gross area":

- Basements not suited as office, special mechanical, or storage space
- Elevator shafts and machinery space
- Exterior walls
- Interior partitions
- Mechanical equipment and water supply equipment space
- Permanent corridors and hallways
- Stairs and stair towers
- Janitor closets
- Electrical equipment space
- Electronic/communications equipment space

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APPENDIX R  
Submittal Register Form  
Not Used

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## APPENDIX AA

### Base Specific Environmental Special Conditions

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS

**1. ENVIRONMENTAL PROTECTION:** All work is to be performed in a manner that prevents pollution, protects the environment, and conserves natural resources.

**1.1 WASTE DISPOSAL:**

**1.1.1. SOLID WASTE DISPOSAL.**

**1.1.1.1. Compliance With Regulations** All waste materials generated by any work under this contract performed on a Government installation shall be handled, transported, stored, recycled, and disposed of by the Contractor and by his/her subcontractors at any time in accordance with these specifications, all applicable Federal, state, or local laws, ordinances, regulations, court orders, or other types of rules or rulings having the same effect of law. These include but are not limited to the Resource Conservation and Recovery Act (RCRA) (40 CFR 260-270); Federal Water Pollution Control Act, as amended (33 USC Sec 1251 ET SEQ); The Clean Air Act, as amended (42 USC Sec 1857 ET SEQ); The Endangered Species Act, as amended (16 USC Sec 1531, ET SEQ); The Toxic Substances Control Act, as amended (15 USC Sec 2601, ET SEQ); The Solid Waste Disposal Act, as amended (42 USC 6901 ET SEQ); the Archaeological and Historic Preservation Act, as amended (16 USC Sec 469, ET SEQ), and the Virginia Solid Waste Management Regulations (9VAC 20-80).

The Contractor shall collect all solid wastes generated during the performance of the contract in a container/area provided by the contractor and approved by the Contracting Officer. The Contractor shall provide appropriate containers for the collection and segregation of solid wastes, recyclables, and C&D debris generated directly and indirectly by work under this Contract. The Contractor is prohibited from using base dumpsters or other government owned/leased waste receptacles for the disposal of any solid wastes. All solid wastes shall be reclaimed, recycled, or disposed of prior to completion of work on LAFB.

As proof of proper disposition of solid wastes, the Contractor shall provide legible weight receipts for solid waste disposed and materials recycled bearing the name, address, and phone number of the receiving facilities for every load of materials delivered. The weight ticket shall detail the type of material, weight of the material in pounds or tons, the date of the transaction, and a signature from a representative of the receiving facility. Receipts shall be submitted to the Contracting Officer within ten (10) calendar days after the transaction.

Under no circumstances will any solid waste or hazardous materials be left at LAFB at the end of the project. Before the project is turned over to the government, the contractor will remove all solid wastes and hazardous materials from the installation. Those items include but are not limited to dirt piles, concrete piles, asphalt piles, and rubbish piles. No materials will be left for the future use of the government UNLESS instructed to do so in writing by the government. This is to include the before mentioned items and also regular or touch-up paint, plaster, solvents, etc. If it is determined that the contractor left materials behind, services may be terminated and/or a penalty payment to include the cost of disposal of the material by the government may be withheld from the project payment.

**NOTE:** Hazardous materials are different from hazardous wastes so be careful not to confuse the two. For hazardous wastes, they will not be removed from the installation without the 1 CES Hazardous Waste Managers signing the Hazardous Waste Manifest. The LAFB Hazardous Waste Managers can be contacted at 757-764-1132/1133 if needed.

#### 1.1.1.2. CONSTRUCTION/DEMOLITION DEBRIS DIVERSION:

As good stewards of the environment, the government is committed to diverting its waste away from landfills to the greatest extent possible. This can be done through recycling, reusing (when directed by the government), and donating construction and demolition debris materials. The contractor shall recycle all construction/demolition debris to the maximum extent possible. The Contractor shall make every effort to recycle materials such as but not limited to concrete (including concrete with rebar), brick, asphalt, all metals, wood, roofing materials, wallboard, ceiling tiles, etc. With prior coordination through the CO and 1 CES/CEV, the contractor may take scrap metals to the Langley AFB scrap metal yard for recycling. The following are some suggested local sites for recycling construction and demolition debris:

Local Sources of Recycling				
Company	Address	City	Phone	Acceptable Items
Tidewater Fibre	5602 Chestnut Ave	Newport News	247-5766	paper, cardboard, plastics, aluminum, glass, tin cans
Old Dominion Recycling	1618 W. Pembroke Ave.	Hampton	723-2942	Aluminum, copper, steel, iron, metals, paper, tires
Butler Paper	324 Newport St	Suffolk	539-2351	Industrial & Commercial Paper Recycling
Dubin Metals	2409 Bowdens Ferry Rd	Norfolk	622-3970	Scrap Metals, Copper, Brass, Batteries, Radiators, Aluminum
Gutterman Iron & Metal	1206 E. Brambleton Ave.	Norfolk	627-1095	Scrap Brass, Copper & Aluminum
Sims Metal	2116 George Washington Memorial Hwy	Tabb	599-4940	Steel, aluminum, brass, copper, stainless steel, radiators
Waterway Marine Terminal	1401 Precon Drive	Chesapeake	333-3427	all C & D materials i.e. concrete, concrete w/rebar, lumber, asphalt
Waterway Materials Corp	1401 Precon Drive	Chesapeake	545-0004	Concrete, concrete w/rebar, brick, block, asphalt
K.F. Wilson	2972 N. Armistead Ave	Hampton	865-7182	all C & D materials i.e. concrete, concrete w/rebar, lumber, asphalt
CrushCon Aggregates	100 North Park Lane	Hampton	723-1131	Concrete, concrete w/rebar



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**1.1.1.2.1 RECYCLING AND DISPOSAL REPORTING:** The Contractor shall report on a quarterly basis the tonnage of the items recycled and the amounts disposed of by landfill and amounts disposed of by regular or waste-to-energy incineration to the project manager, the Contracting Officer, and 1 CES Environmental Flight (1 CES/CEVQP) by the 5<sup>th</sup> day of each quarter (Jan, Apr, Jul, Oct) during the period of performance. This report will be for the previous quarter. The report shall list the title of the project, the project number, the Contractor's company name and point-of-contact, phone number, the type items (i.e. concrete, concrete with rebar, asphalt, brick, scrap metals, wood, wallboard, etc) and the tonnage of those items recycled. For all items that could not be recycled, the contractor will provide a brief reason as to why the items could not be recycled.

For items disposed of, one total tonnage can be given for items landfilled and one total tonnage for items incinerated (specify waste incinerator or waste-to-energy incinerator) instead of reporting disposal figures for the various items. For items that cannot be accurately measured, estimates will be sufficient. Use the form at Attachment 1 to report this information to the Contracting Officer, project manager, and to 1 CES/CEVQP.

To send it to 1 CES/CEAQP, email it to [1CES.CEV@langley.af.mil](mailto:1CES.CEV@langley.af.mil) or mail it to:

1 CES/CEAQP  
Attn: Pollution Prevention Mgr  
Bldg 328, Room 253  
37 Sweeney Blvd  
Langley AFB VA 23665

**1.1.1.3 Contain Loose Debris.** Loose debris on trucks leaving the site shall be loaded in a manner that shall prevent dropping of materials on streets and conform to local ordinances/laws. Fasten a suitable cover, such as a tarpaulin, over the load before entering surrounding streets.

**1.1.1.4 Trip Tickets.** Contractor shall submit all trip tickets from the landfill facility, incinerators, and recycling companies to show all debris is being landfilled, incinerated, or recycled in accordance with all Federal requirements and in an approved location. These trip tickets will be submitted to the Contracting Officer who will in turn give them to the project manager.

**1.1.2. PETROLEUM CONTAMINATED WASTE:**

**1.1.2.1. Contaminated Absorbents.** All petroleum spills must be cleaned up using absorbent materials. Spills caused by the contractor will be the contractor's responsibility to containerize and dispose of the contaminated absorbent material. Spills caused by the government will be the responsibility of the government. Contact the base hazardous waste contractor Chugach at 225-5808 or 225-5809 to arrange for pick-up.

**1.1.2.2. Waste Soil.** Suspect soil must be tested to determine if it contains any contaminants prior to relocating it. Testing and disposal of soil shall follow Virginia Solid Waste Management Regulations 9VAC-20-80-700 (soil contaminated with petroleum products). Testing shall

include: Total Petroleum Hydrocarbon (TPH), Total Organic Halogens (TOX), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX), and Toxicity Characteristic Leaching Procedures (TCLP). If test results determine "other than clean", the material will have to be transported to an appropriate landfill or processing center based on the contaminants identified. Contaminated soils, in sludge or slurry form, shall be containerized and managed as either hazardous waste or non-regulated waste, depending on what contaminate was spilled. The containerized contaminated soil shall the responsibility of the contractor to dispose of such. CEV must review the sample results and sign all hazardous/non hazardous waste manifests prior to disposal. Contact 1 CES/CEVC Hazardous Waste Program Managers for additional information.

**NOTE:** UNDER NO CIRCUMSTANCES will soil, clean or contaminated, from Langley AFB be delivered to or donated to off-base sources (other than an appropriate landfill or processing center based on the contaminants identified) for use. Soils donated to off-base entities for use will be the sole liability and responsibility of the contractor.

### **1.1.3. UNIVERSAL WASTE:**

**1.1.3.1. Fluorescent Lamps.** The contractor shall use environmentally-friendly green tip fluorescent lamps during lamp replacement. Upon removal of old Sylvania lamps and high intensity bulbs, the contractor will box the lamps and manage them as universal waste. Other lamps (i.e. GE and Phillips) may be disposed directly in to regular trash. Contact the base hazardous waste contractor at 225-5808 or 225-5809 to arrange for pick-up, except in cases where lamp replacement is part of the contract. Lamps will be properly disposed of by the contractor with waste manifest being signed by 1 CES/CEANC Hazardous Waste Program Managers.

### **1.1.4. HAZARDOUS WASTE.**

**1.1.4.1. SITE MANAGEMENT.** All material containers must be closed when not in use. Materials are to be covered as protection from weather. Each container is to be properly labeled. Do not store hazardous materials near storm drains. Upon completion of this project the contractor shall remove all hazardous materials and hazardous waste (for associated manifest requirements see paragraph 1.1.4.2.)

**1.1.4.2. MANIFESTS.** 1 CES/CEVC will review all lab analysis or MSDS of wastes prior to signing manifests. All hazardous waste manifests must be signed by 1 CES/CEANC prior to removal of such waste from the base. The generator copy of the manifest must be returned to 1 CES/CEANC, 37 Sweeney Blvd, LAFB VA 23665.

**1.2 FUEL, SEWAGE, AND OTHER SPILLS:** In the event of a fuel, sewage, and other toxic spillage during the performance of this contract, the Contractor shall be responsible for its containment, clean up, and related disposal costs and will notify 1 CES/CEVC immediately. The operator shall have sufficient spill response supplies readily available on the pumping vehicle and/or at the site to contain any spillage. In the event of a Contractor-related release, the Contractor shall **immediately** notify the Environmental Management Office and the Contracting Officer and take appropriate actions to correct its cause and prevent future occurrences. If the

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federal, state, or local authorities assess any monetary fine, penalty, or assessment related to the release of any substance by the Contractor, his/her employees, or agents during the performance of this contract, the Contractor shall be solely liable for its payment, authorizes the United States Air Force to withhold such from payment and otherwise indemnify and hold the United States Air Force harmless.

**1.3 ASBESTOS OR LEAD BASED PAINT** *[Contact 1 CES/CEANC to determine any known presence of these materials]*

**1.3.1. ASBESTOS PRESENCE:** [Tests have indicated that asbestos is not present in the areas affected by this work //or// Tests have indicated the presence of asbestos in the areas affected by this work.] If asbestos not previously known to exist is exposed, the Contractor shall cease work in the affected area and notify the Contracting Officer.

**1.3.1.1. ABATEMENT PLAN:** *[Include if project requires asbestos removal]* Abatement plans are to include but not limited to the description of how abatement is to be accomplished, required notifications, required licensing, employee safety requirements, and air sampling.

**1.3.1.2. ASBESTOS ABATEMENT OR REMOVAL NOTIFICATION:** *[Include if project requires asbestos removal]* Contractor is responsible for disposal of Asbestos debris. Contractor is subject to OSHA, EPA and Commonwealth of Virginia compliance and inspection for asbestos removal. Contractor must perform asbestos removal work in accordance with these specifications and EPA National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for asbestos and any subsequent updates thereto. This includes state and EPA Region 3 notifications that shall be accomplished at least 20 days prior to starting any asbestos abatement or removal. A copy of the notification shall be submitted to the Contracting Officer.

**1.3.1.3. ASBESTOS MANIFESTS:** *[Include if project requires asbestos removal]* All asbestos waste manifests shall be signed by 1 CES/CEV (37 Sweeney Blvd) prior to removal of such waste from the base. A copy of the completed manifest (signed by the receiving landfill) shall be submitted to 1 CES/CEANC.

**1.3.2. LEAD BASED PAINT PRESENCE:** [Tests have indicated that lead based paint is not present in the areas affected by this work //or// Tests have indicated the presence of lead based paint in the areas affected by this work.] If lead based paint not previously known to exist is exposed, the Contractor shall cease work in the affected area and notify the Contracting Officer.

**1.3.2.1. ABATEMENT PLAN:** *[Include if project requires lead based paint removal]* Abatement plans are to include but not limited to the description of how abatement is to be accomplished, required licensing, employee safety requirements, and air sampling.

**1.3.2.2. LEAD BASED PAINT DISPOSAL.** Once removed, lead based paint shall be disposed of as hazardous waste. Disposal of lead debris containers is the responsibility of the Contractor. Lead contaminated debris must be sampled to determine the level of lead. The analysis will determine waste management procedures. 1 CES/CEANC will inform the Contractor on management procedures. If wastes are determined to be hazardous by regulatory

criteria, the containers cannot leave the installation until a completed manifest is reviewed and signed by 1 CES/CEANC. The Contractor must contact Chugach at 225-5808/09 to store full drums of lead contaminated waste at the < 90 day site located at 510 Poplar Rd. The drum/s must be in good condition, labeled properly and closed. The contractor has less than 90 days of storage on base before the containers must leave the installation.

#### 1.4 AIR QUALITY

**1.4.1. VOLATILE ORGANIC COMPOUNDS:** All coatings and solvents used in the performance of this contract shall meet the required performance specifications and shall not exceed the volatile organic compound limits of the Air Pollution Control Districts where they are used.

**1.4.2. DUST:** *[If the project is likely to create dust emissions, the following requirement applies]* Mitigation of fugitive dust emissions shall be accomplished in accordance with 9 VAC5-40-90, Standards for Fugitive Dust/Emissions.

**1.4.3. BOILERS:** *[Include if a boiler is installed as part of this project]:* To meet permit requirements, submit required data (mmBtu/hour) for each boiler installed to 1 CES/CEANC.

**1.4.4. GENERATORS:** *[Include if an emergency generator is installed as part of this project]* To meet permit requirements, submit required data (Kilowatt (KW) rating) for each emergency generator installed to 1 CES/CEANC.

#### 1.4.5. OZONE DEPLETING SUBSTANCES (ODS)

Contracts may not include any specification, standard, drawing, or other document that requires the use of a Class I ODS in the design, manufacture, test, operation or maintenance of any system, subsystem, item, component, or process. Contracts may not require the delivery of any items of supply that contains a Class I ODS or any service that includes the use of a Class I ODS.

**1.5 STORAGE TANKS:** *[Include only if work includes or is in area of storage tanks; contact 1 CES/CEANC to determine any known history or presence of storage tanks]*

**1.5.1. STORAGE TANK SERVICE NOTIFICATION:** *[Include if an AST or UST is going to be installed]:* Notify 1 CES/CEVC 30 days prior to the tank being put into service to meet regulatory documentation requirements.

**1.5.2. DISPOSAL OF PETROLEUM CONTAMINATED SOIL:** *[Include if excavating around any removed, abandoned, or in-service AST or UST]:* Contaminated soil may be encountered in proximity to previous and current tank sites. Disposal of such soil must be funded as part of this project. Waste must be disposed of IAW previous WASTE DISPOSAL paragraph, 1.1.2.2, along with applicable State and Federal regulations. If contaminated soil is discovered, notify 1 CES/CEANC Hazardous Waste Program Managers prior to disposal.

**1.5.3. ABOVEGROUND STORAGE (AST) TANKS:** *[Include if there is going to be an AST temporarily or permanently installed]:* Any above ground storage tanks (ASTs) allowed on site

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shall have secondary containment, venting and spill/overflow protection. Anti-siphon valves are required. The Contractor shall visually inspect such tanks daily for leaks. All ASTs shall be installed or erected in accordance with VR 680-14-13, NFPA 30, and 40 CFR 112.7.

**1.5.3.1. NOTIFICATION:** If Aboveground Storage Tank (AST) is removed or re-located, the project manager is required to notify the 1 CES/CEANC Tank Program Manager prior to the action so regulatory documentation can be initiated.

**1.5.4. UNDERGROUND STORAGE TANKS:** *[Include if there is going to be construction or excavation where there is an abandon UST]*. Underground Storage Tanks (UST) located within project area present an underground hazard and the work should to be routed around the site or other provisions made. Contact 1 CES/CEANC (Tank Program Manager) for additional information.

**1.6 WATER QUALITY:** *[Include if there is going to be exterior material laydown, construction, or excavation]*.

**1.6.1. EROSION AND SEDIMENT CONTROL:** All construction operations shall comply with the requirements of the Virginia Erosion and Sediment Control Act. An Erosion and Sediment Control Plan shall be prepared prior to initiating groundbreaking activities. A copy of the E&SC Plan shall be forwarded to 1 CES/CEANC (Water Program Manager). Hay bales shall not be used for erosion control and inlet protection from storm water run-off. The Contractor shall submit alternate methods of protection to the Contracting Officer at the preconstruction conference for review and approval. The Contracting Officer will notify the Contractor of his/her decision prior to issuance of Notice to Proceed (NTP).

**1.6.2. STORMWATER PERMIT.** If over 2500 square feet of soil is to be disturbed as part of the project, the contractor shall obtain a Stormwater General Construction Permit from the Virginia Department of Conservation and Recreation (VDCR). A stormwater pollution prevention plan (SWPPP) shall be prepared to support the stormwater permit; a copy of the SWPPP shall also be forwarded to 1 CES/CEANC (Water Program Manager). The contractor is solely responsible for obtaining, funding, and complying with the terms of the permit. A copy of the permit shall be forwarded to 1 CES/CEANC (Water Program Manager).

## **1.7. HAZARDOUS MATERIALS MANAGEMENT**

**1.7.1. Hazardous Materials Usage and Reporting:** In compliance with AFI 32-7086 dated 1 Nov 2004 and AFI 32-7086 ACC Sup 1, all contractors are required to report the usage of all hazardous materials to the government for all projects and contracts including service contracts executed on LAFB. In accordance with FAR Clause 52.223-3, each offeror (Contractor) must provide the Contracting Office with a list of proposed HAZMAT that it plans to use on the installation during the performance of the contract. In accordance with AFFARS Clause 5352.223-9303, contractors must obtain Air Force authorization prior to using HAZMAT on an Air Force installation, and must report usage data to the HAZMART.

Hazardous materials are any substance defined by OSHA as a hazardous substance requiring a Material Safety Data Sheet (MSDS). Hazardous materials that need to be reported include but are not limited to chemicals, paints, thinners, sealing compounds, strippers, glues, solvents, all petroleum products including oils, hydraulic fluids, and fuels stored on-site (fuels in vehicles are exempt), pesticides, adhesives, acids, flammables, corrosives, oxidizers, compressed gases (such as but not limited to oxygen, acetylene, propane, flammable and non-flammable gases), all aerosols, and all materials containing hazardous substances.

The contractor shall request the proposed usage of all Hazardous Materials by completing the "Contractor Hazardous Material Worksheet" at attachment 2 for each hazardous material and shall submit a copy of the Material Safety Data Sheet (MSDS) for each item to the Contracting Officer (CO) prior to bringing the items on the installation. The Contractor shall submit to the CO the information for each item within 10 days after award of the contract or project and/or not less than fourteen calendar days prior to bringing the items on the installation. For short notice contracts or projects, the contractor will submit this information to the CO as soon as possible. An electronic version of the Contractor Hazardous Material Worksheet can be obtained through the project manager or 1 CES/CEVQP.

The CO will immediately provide this information to the project manager who will in turn provide it to 1 CES/CEVQP immediately.

After the project starts, monthly usage information will be provided to the CO who will in turn provide this information to the project manager who will in turn provide it to 1 CES/CEVQP. The form at Attachment 3 will be used to report monthly usage. For contracts/projects exceeding six months, this form is required to be filled out on a monthly basis. For contracts less than six months, this form is required at the beginning and at the completion of work.

If there are any questions on how to fill out the Contractor Hazardous Material Worksheet or the monthly report, contact the LAFB HAZMART at 757-764-3837 Monday thru Friday between the hours of 0730-1630 or visit them at:

1 LRS/HAZMART  
Bldg 330  
23 Sweeney Blvd  
Langley AFB VA 23665

**1.7.2. Hazardous Materials Management Process (HMMP):** The LAFB HMMP team will meet on a weekly basis or an as-needed basis to review the Contractor Hazardous Material Worksheets and MSDSs to ensure there are no concerns with the chemicals being used and/or stored on the installation. If there are concerns about any chemicals and if it is determined that the contractor plans to use an extremely hazardous chemical on LAFB, the HMMP team will notify the project manager and the Contracting Officer (CO) who will in-turn notify the contractor of LAFB's concern. The contractor will not bring any extremely hazardous chemicals on LAFB or any other chemicals that the HMMP team determines cannot be used on Langley.

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The HMMP team will also notify the project manager if all hazardous materials are authorized for use.

If the contractor requires additional hazardous materials not previously submitted for approval, they shall submit the request as stated above seven days prior to bringing the item on the base.

**NOTE:** If it is determined at any time that hazardous materials are on site that were not reported in advance, the CO will be notified and the project can be stopped until the materials are submitted as stated above.

**1.7.3. Hazardous Material Storage:** Hazardous materials will be managed properly at all times while on LAFB. This means containers will be in good condition and will be properly labeled with the contents and hazard class (flammable, corrosive, oxidizer, etc) at all times. Containers will be closed at all times when not in use, hazardous materials will be kept under cover to protect them from the elements and to prevent stormwater runoff contamination, and tanks and 55-gallon liquid drums will have secondary containment. Gas cylinders will be maintained in the upright position with caps on and will be secured with chains and locks to prevent tampering and to prevent them from falling over. Gas storage areas will have signs indicating what type gases are stored in the area (ie flammable, oxidizer, non-flammable, etc). NO SMOKING signs will be posted in all hazardous materials storage areas. In addition, all hazardous materials will be segregated in storage according to compatibility (ie flammables will not be stored with corrosives, corrosives will not be stored with oxidizers, flammable gases will not be stored with flammable liquids, etc). LAFB is subject to inspections at any time from outside agencies (EPA, Virginia Dept of Environmental Quality, and OSHA) and any violations by the contractor will be the responsibility of the contractor and any fines associated with the violations will be resolved at the contractor's expense.

**1.8 USE OF RECYCLED-CONTENT PRODUCTS: (GREEN PROCUREMENT):**

Whenever the potential for use of non-recycled content products exists during the construction stage of the project, the Contractor shall incorporate in this project, as a substitute, recycled-content products that are listed and identified in the Environmental Protection Agency (EPA) Comprehensive Procurement Guidelines (CPG) for recycled-content products. The Contractor shall use recycled-content products as required by EPA and other governmental agencies and Federal Acquisition Regulation (FAR) clauses.

It is mandated by Executive Order 13101 (Greening the Government through Waste Prevention, Recycling, and Federal Acquisition) and Section 6002 of the Resource Conservation and Recovery Act (RCRA) that the Federal Government use recycled-content products in the construction and/or renovation of facilities. It is the intent of the Government to comply with the Environmental Protection Agency (EPA) requirement 100% of the time and use as many of the applicable listed recycled-content products as feasible and economically practical. The Contractor shall consider this a standard requirement for all aspects of the project construction.

The recycled-content products listed in the CPG can be found in the EPA website at [www.epa.gov/cpg/products.htm](http://www.epa.gov/cpg/products.htm). These products are also listed at Attachment 4. This list is

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subject to change at any time so it is the Contractor's responsibility to be aware of any updates or additions.

Such products shall also comply with the requirements of the EPA Recovered Materials Advisory Notice (RMAN). The RMANs recommend recycled-content ranges for CPG products based on current information on commercially available recycled-content products. The recommended recovered materials content percentage can be obtained by clicking on the product on the website.

**1.8.1. Green Procurement Forms** Before starting the project, the Contractor shall complete attachment 4 indicating the items he plans to use. The Contractor will provide this to the Contracting Officer and the project manager. Then during the accomplishment of the project construction, the Contractor shall complete the form again. At this time, the Contractor shall indicate the use and non-use of products that are contained in the CPG and will list the recycled-content percentage for the applicable item. In each instance where a recycled-content construction product is not used, the Contractor shall provide to the Contracting Officer (or his/her designated representative) and the project manager a completed Exemption Form, attachment 5, "Recovered Materials Determination Form".

The Contractor shall complete this form for all items for which he or she desires an exemption from the Green Procurement Program for Recovered Materials that are being procured. Exemptions can only be taken if (1) the item is not available within a reasonable period of time (2) item fails to meet a performance standard in the specifications and (3) the item was only available at an unreasonable price i.e., the recycled-content product costs more than the non-recycled content product. The fourth reason on the Recovered Materials Determination Form, (4) the item is not available from 2 or more sources, does not apply to construction/renovation contractors as the Government will not specify where you can get your materials from. Specific reasons why an exemption is taken will be specified on the form and documentation supporting this reason will be provided and attached.

The Contractor will sign the form as the "Procurement Originator" and the completed form will also be signed by the 1 CEP Engineering Flight Chief or Deputy Flight Chief. These forms will be kept in the project folder indefinitely.

## **1.9 ENVIRONMENTAL RESTORATION PROGRAM (ERP) REQUIREMENTS:**

**[Include only if work is in ERP area. Ensure drawings define ERP boundaries and well locations]**

**1.9.1. Contaminated Soil and Free Product:** Any material (soil) that is suspected of containing petroleum products shall be reported to the Contracting Officer or his/her designated representative. If discovered, the Contractor shall mitigate any potential threat to the workers, public and environment. The area that will be disturbed under this contract has the potential to have free product migrate into and under the construction site. Comply with VR-680 and record the quantity of any fuel removed from **[the line]**. Contaminated soil and/or free product shall not be used for backfill or removed from the base without written approval from the Contracting



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Officer. Once removal is approved, Contractor shall dispose of material under guidance of the Hazardous Waste Managers (1 CES/CEA). All hazardous waste manifests shall be prepared by the Contractor and shall be coordinated, approved and signed by 1 CES/CEANC Hazardous Waste Manager (37 Sweeney Blvd) prior to removal of such waste from the base.

**1.9.2. Site Safety:** Site summaries from our Management Action Plan are furnished with this contract to familiarize personnel with the potential hazards associated with construction and demolition work at these sites. Ensure workers are informed of potential hazardous exposures from working at these sites, and that the appropriate precautions are followed to minimize hazards to human health and the environment. Personnel working at these sites shall have 40-hour HAZWOPER Training. At least one individual on site should have completed the OSHA 8-hour supervisor training course. The plans identify the boundary of these IPR sites. To perform work at these sites, the Contractor must have a Health and Safety Plan and Hazardous Waste Disposal Plan for proper disposal of all regulated materials generated during execution of this project.

**1.9.3. Monitoring Wells:** There may be several monitoring wells installed in and around the proposed construction area. Site maps and construction drawings provide the location of these wells. The Contractor shall take all precautions to prevent any damage to wells. If the wells and associated structures are damaged during the project, the Contractor shall repair/replace all damages at no additional expense to the Government. Contractor shall dispose of all regulated materials during repair of the damaged structures and remove any free product as required by VDEQ regulations.

**1.9.4. Additional Excavation:** Prior to any excavation beyond the immediate area or boundary of the construction site, the Contractor shall coordinate with 1 CES/CEA and obtain the Contracting Officer's approval.

## **1.10 SOIL SUPPORT PROGRAM (SSP) ACCEPTABILITY**

The soils obtained from off-base sources shall meet the criteria outlined below. The soils generated during construction project excavation will be collectively referred to as project (soil) media. Soil media is not inherently waste-like, but it may contain waste-like materials, including contaminants associated with the site. Given the base history of operations, the contractor must make a determination of whether the soil is contaminated. If the media is determined to be contaminated, then a hazardous waste determination must be made. Standards for testing are described below. The contaminated media will be managed as a solid waste and removed from base. If the media is determined to be uncontaminated and not waste-like, then it may be disposed on site in an environmentally sound manner.

**1.10.1. Clean Soil.** Projects requiring clean soil, including but not limited to top soil and backfill materials, to be brought onto Langley AFB or relocated within base property must meet minimum standards based on results of physical (geotechnical) and chemical testing. All materials will meet physical (geotechnical) specifications appropriate for the type of project being accomplished and are typically identified elsewhere in the project specifications. The intent of this section is to prevent contamination from borrowed sources (i.e. planned excavation)

and define clean soil based on chemical specifications. Levels of chemical contamination will be determined to ensure borrow soils may be used for the current and future use of the project location. The contractor shall implement a plan and confirm the proposed borrow soils meet clean soil requirements. The plan should incorporate borrow source information, sampling data, and testing results. As a minimum, the following standards must be met:

**1.10.2. Borrow Source.** The contractor shall provide detailed borrow source information (e.g., location, owner, operator, past and current land use, previous chemical testing results) at the point of planned excavation to 1 CES/CEA to determine chemical testing requirements. The contractor shall also submit a certification stating the materials contain no asbestos, no gross contamination have been discerned by visual or olfactory observations, and no spills of a listed hazardous waste (40 CFR 261) have occurred at the borrow site. If previous chemical testing results exist and are provided, 1 CES/CEA will evaluate those results to determine if they are sufficient and the proposed borrow soils meet clean soil requirements. If testing is incomplete, 1 CES/CEV will review borrow source information to determine chemical sample requirements.

**1.10.2.1. On-base Soil Sources.** Unless otherwise provided in the contract, the contractor shall bear all expenses of developing the source. For the site where soil is reclaimed from government land, the contractor may be required to perform final grade and seeding according to project requirements.

**1.10.2.2. Excess Soil Work.** Acceptable excess soil shall be delivered to the designated location(s) following approved haul routes. For the site where excess soil is deposited on government land, the contractor may be required to perform final grade and seeding according to project requirements.

**1.10.3. Sample Plan.** At least one composite sample (6-8 grabs) for each undisturbed borrow source would be taken from the original point of excavation and required for each 5,000 CY of soil. For soil taken from disturbed borrow sources, samples are required for each 1,000 CY of soil. The nature of the borrow source is to be considered when determining the quantity and depth of the samples. Additional samples may be required to adequately characterize the proposed borrow source (i.e. laterally and vertically). The contractor shall submit a Sample Plan (to include site map, excavation area, location and depth of samples) for 1 CES/CEA review and approval.

**1.10.4. Chemical Testing Standards.** The analysis must be performed by a laboratory approved by the U.S. Environmental Protection Agency. Submit a copy of the chain of custody and complete validated report of analysis to 1 CES/CEA for review and approval 30-days prior to use of any borrow soils. Chemical testing of any borrow source will include sampling for the following suite of contaminants (test requirements may be reduced based on borrow source information):

- Total Petroleum Hydrocarbons (TPH) to include Gasoline Range Organics (GRO) and Diesel Range Organics (DRO);
- Volatile Organic Compounds (VOCs) [EPA method 8260B] to include Benzene, Toluene, Ethylbenzene, and Xylene (BTEX);

SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS

The soil support test suite shall also include unless generator knowledge suggests otherwise:

- Semi-volatile Organic Compounds (SVOCs) [EPA method 8270];
- Pesticides [EPA method 8081A];
- Polychlorinated Biphenyls (PCBs) [EPA method 8082]; and
- Target Analyte List (TAL) metals (including Mercury) [EPA method 6010B/7470A]
- Volatile Organic Compounds (VOCs) [EPA Method 8260] other than BTEX compound reference in the preceding paragraph.

**1.10.5. Clean Soil Determination.** Soils testing under the EPA screening levels and/or base “background” levels will be considered acceptable “clean” soil. Generally, acceptable clean soil must not exceed EPA Region III “Residential” Risk Based Concentrations (RBC) and the LAFB Upper Tolerance Limit (UTL) background soil concentrations. For use in current and future industrial areas, EPA Region III “Industrial” RBCs may be considered but shall not exceed UTL background levels.

**1.10.6. Excavation and Delivery Screening.** Common to any multiple point sampling, composite testing may not accurately characterize the entire site. Should contamination be detected (e.g. free product, stained soils, chemical odors) during excavation or delivery, soil operations shall be immediately discontinued pending 1 CES/CEV notification and resolution. Additional soil testing and screening may be required to determine if continued use of the borrow site is acceptable.

**1.10.7. Material Physical Characteristics.** All soil obtained from sources within or outside the limits of government-controlled land shall meet the physical characteristics as defined in project specifications.

## **1.11 TREE PROTECTION, PRESERVATION, AND PLANTING**

**1.11.1. Tree Protection** – trees take generations to mature, yet they can be irreparably damaged or killed within seconds, or subjected to conditions which may take five (5) to ten (10) years to kill them. Improper planting may result in short-term death, structural failure, or a long-term senescence. Most situations can be prevented.

**1.11.2** Because trees contribute so much to our quality of life and because they can be a potential liability, they must be actively conserved, wisely selected, well placed, well planted, routinely maintained, and constantly protected. One of the most critical steps in planning for trees and cost effective ways of managing trees is to maintain adequate growing space for each tree’s roots, trunk, and crown throughout the tree’s life. Remember that as a tree gets older it gets larger and the growing space it requires increases accordingly.

**1.11.3.** For existing trees, there is a minimum amount of area, above (for the trunk and crown) and below ground (for soil health and the root system) that is required to protect trees and preserve tree health. This area has been identified as the critical root zone (CRZ) or tree protection zone (TPZ) by various experts and is generally agreed to be equivalent to the soil area

SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS

below ground and the space above ground defined by the tree's dripline, or the greatest extent of the branches. This is depicted in Figure 1

**1.11.4.** However, for small trees, newly planted trees, and trees with narrow crowns, the dripline defines an area that is too small for proper protection. So it is best to define both the critical root and tree protection zones as the circular area above and below ground with a radius equivalent to the greater of 6 feet or 1.5 feet for every inch in trunk diameter at 4.5 feet above the ground. For example, a tree with a trunk diameter (dbh) of 20 inches has a CRZ and TPZ of 30 feet (20 inches x 1.5) around the tree. While the radius of the CRZ (and TPZ) is 30 feet, the diameter of the entire CRZ (and TPZ) is 60 feet.

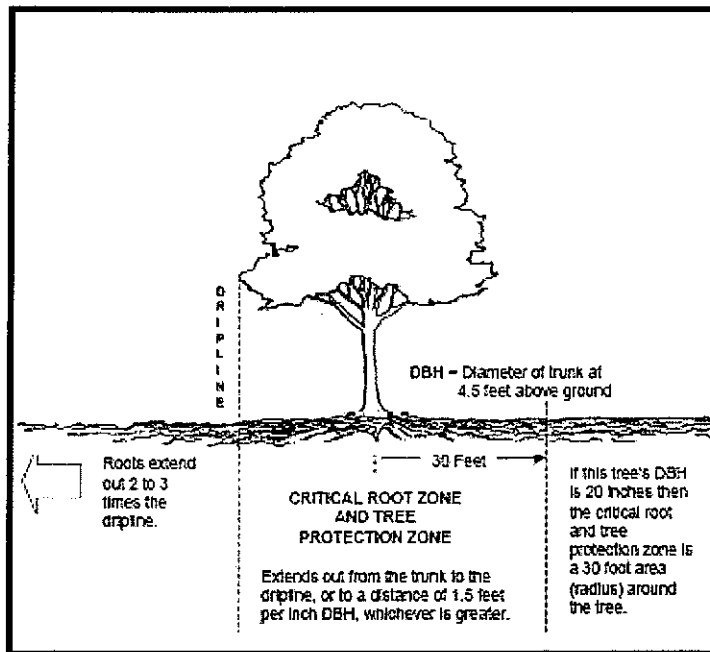
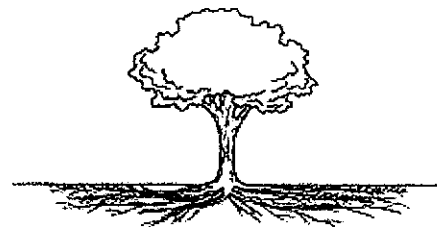


Figure 1. Location of the Critical Root Zone and Tree Protection Zone

## Guide to Working Around Trees - How Trees Are Damaged During Construction

### Physical injury to the trunk and crown

Construction equipment can injure the above-ground portion of a tree by breaking branches, tearing the bark, and wounding the trunk. These injuries are permanent, and if extensive, can be fatal.



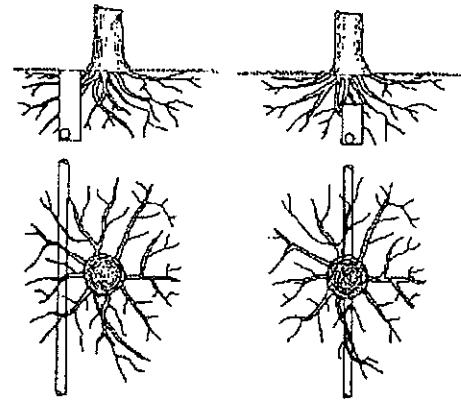
**The roots of a tree will extend far from the trunk and will be found mostly in the upper 18 inches of the soil.**

### Physical injury to the trunk and crown

- Soil compaction in the root zone
- Severing of roots
- Smothering roots by adding soil
- Split and broken branches
- New exposure to wind and sunlight

SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS**Soil compaction**

An ideal soil for root growth and development is about 50% pore space. These pores, the spaces between soil particles, are filled with water and air. The heavy equipment used in construction compacts the soil and can dramatically reduce the amount of pore space. This not only inhibits root growth and penetration but also decreases oxygen in the soil that is essential to the growth and function of the roots.



**Less damage is done to tree roots if utilities are tunneled under a tree rather than across the roots.**

**Need Assistance ?****1<sup>st</sup> Civil Engineer Squadron**

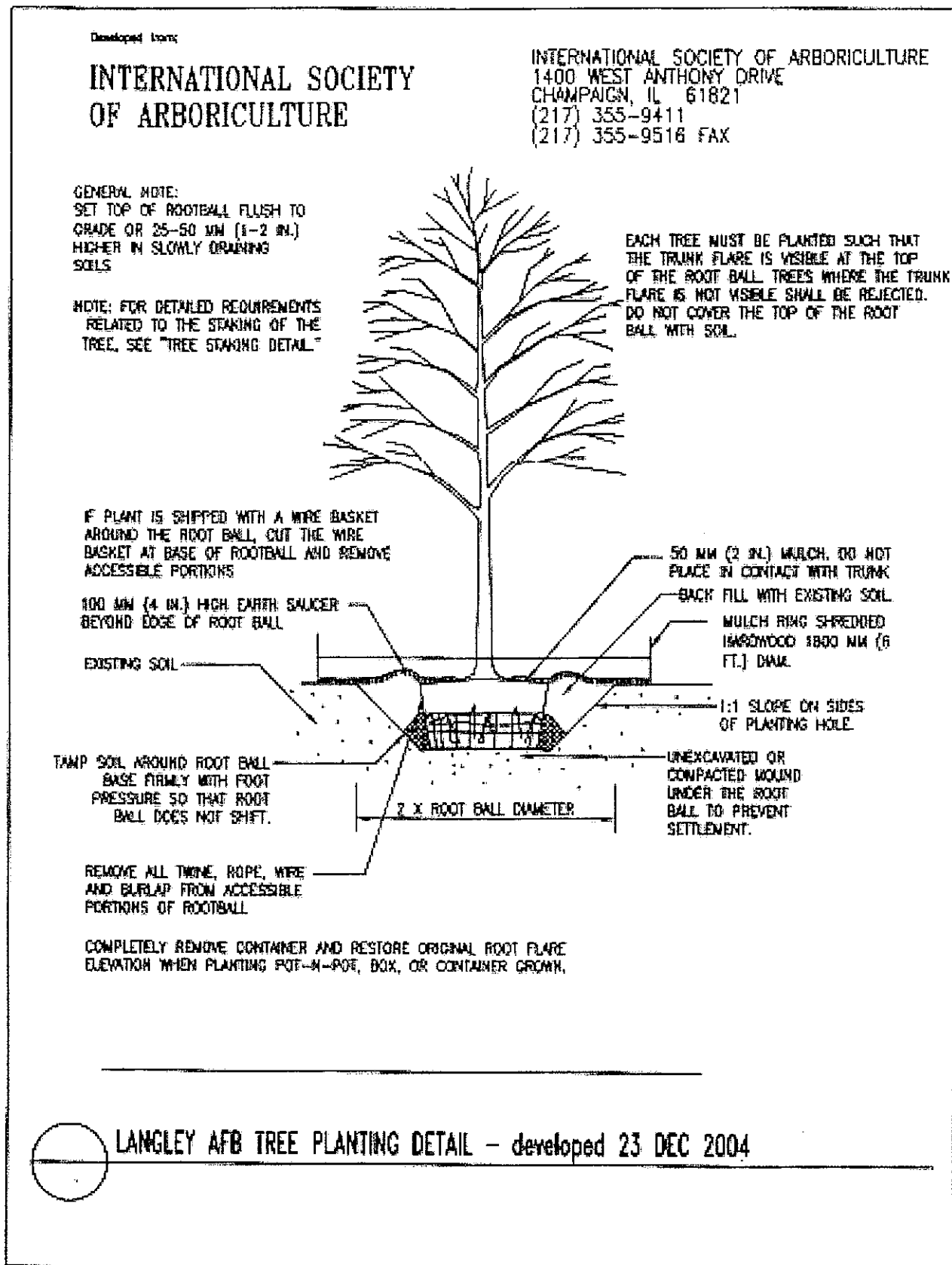
H. Reed Jeavons  
Environmental Management Flight  
Natural Resources Planner  
ISA Certified Arborist #MA-0674A

1 CES/CEV DSN 574-1090  
37 Sweeney Blvd COMM/VOICE: (757) 764-1090  
Langley AFB, Virginia 23665-2107 FAX: (757) 764-8615  
e-mail: [harry.jeavons@langley.af.mil](mailto:harry.jeavons@langley.af.mil)

**Cutting of roots**

The digging and trenching that are necessary to construct a house and install underground utilities will likely sever a portion of the roots of many trees in the area. It is easy to appreciate the potential for damage if you understand where roots grow. The roots of a mature tree extend far from the trunk of the tree. In fact, roots typically will be found growing a distance of 1-3 times the height of the tree. The amount of damage a tree can suffer from root loss depends, in part, upon how close to the tree the cut is made. Severing one major root can cause the loss of 5-20% of the root system.

## SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS



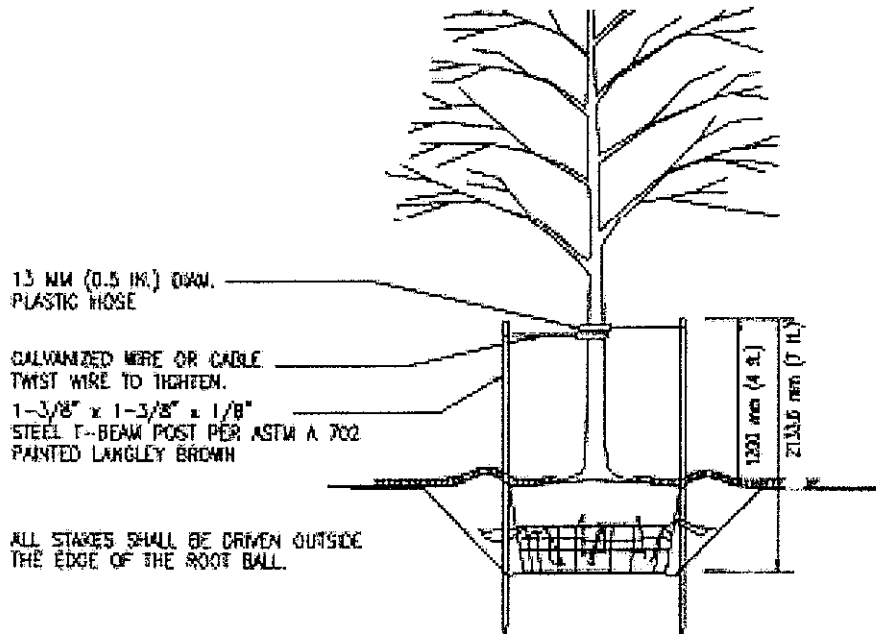
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original available from [www.caddetails.com](http://www.caddetails.com)

SECTION 01120 - ENVIRONMENTAL SPECIAL CONDITIONSDEVELOPED FROM:  
**INTERNATIONAL SOCIETY  
OF ARBORICULTURE**INTERNATIONAL SOCIETY OF ARBORICULTURE  
1400 WEST ANTHONY DRIVE  
CHAMPAIGN, IL 61821  
(217) 355-9411  
(217) 355-9516 FAXWIRE OR CABLE SIZES SHALL BE AS FOLLOWS:  
TREES UP TO 65 MM (2.5 IN.) CALIPER - 14 GAUGE  
TREES 65 MM (2.5 IN.) TO 75 MM (3 IN.) CALIPER - 12 GAUGE

TIGHTEN WIRE OR CABLE ONLY ENOUGH TO KEEP FROM SLIPPING. ALLOW FOR SOME TRUNK MOVEMENT. PLASTIC HOSE SHALL BE LONG ENOUGH TO ACCOMMODATE 35MM (1.5 IN.) OF GROWTH AND BUFFER ALL BRANCHES FROM THE WIRE.

TUCK ANY LOOSE ENDS OF THE WIRE OR CABLE INTO THE WIRE WRAP SO THAT NO SHARP WIRE ENDS ARE EXPOSED.



ASSURE THAT THE BEARING SURFACE OF THE PROTECTIVE COVERING OF THE WIRE OR CABLE AGAINST THE TREE TRUNK IS A MINIMUM OF 12 MM (0.5 IN.).

REMOVE ALL STAKING AS SOON AS THE TREE HAS GROWN SUFFICIENT ROOTS TO OVERCOME THE PROBLEM THAT REQUIRED THE TREE TO BE STAKED. STAKES SHALL BE REMOVED NO LATER THE END OF THE FIRST GROWING SEASON AFTER PLANTING.

## NOTES

1. PLEASE REFER TO INTRODUCTION AND USE CRITERIA PRIOR TO USING THIS DETAIL.

**LANGLEY AFB TREE STAKING DETAIL**

DEVELOPED 27 DEC 2004

**1.11.5 Tree Protection Zone Structures**

- Chainlink fence – 48-inch minimum height
- Snow/Sand fence - 48-inch minimum height
- Safety fence - 48-inch minimum height

**1.12 Discrepancies.** In case of a conflict or discrepancy between environmental regulations or laws and the contract specifications, the Contractor shall immediately submit the matter in writing to the Contracting Officer for a determination. Without such determination any actions taken shall be at the Contractor's own risk and expense.

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**References:**

1. EPA Region III Risk Based Concentration (RBC) table. As this table is updated every 6 months, analysis is to be determined by the table current at the time of testing. This table can be found at <http://www.epa.gov/reg3hwmd/risk/human>.
2. Background Chemical Data Document for Langley AFB, 21 Oct 97, Table 7-1. The UTL (Upper Tolerance Limit) Summary Table outlines the Langley AFB's background data set. This table can be requested through 1 CES/CEV.



SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS

## ATTACHMENT I

## CONSTRUCTION/DEMOLITION DEBRIS RECYCLING AND REPORTING

As stewards of the environment and because of the Air Force goals of diverting greater than 40% of its waste away from landfills, contractors shall recycle C&D debris to the maximum extent possible. There are many sources in the local area that can recycle C&D. A list of sources can be found in the "Special Conditions" portion of Langley construction contracts. If you need further assistance finding sources, contact the 1 CES/CEV Pollution Prevention Manager at 757-764-3987. Langley AFB must report recycling metrics to higher Headquarters quarterly. Therefore, complete the form below for each project on Langley AFB and submit a copy to the 1 CONS Contracting officer, the 1 CES/CEC project manager, and 1 CES/CEVQ Pollution Prevention Program Manager by the 5<sup>th</sup> day of each quarter (5 Apr, 5 July, 5 Oct, and 5 Jan) for the previous three month period for the duration of the project.

PROJECT NUMBER AND TITLE: \_\_\_\_\_

PROJECT LOCATION (BLDG # AND STREET ADDRESS): \_\_\_\_\_  
\_\_\_\_\_

CONTRACTOR NAME: \_\_\_\_\_

CONTRACTOR ADDRESS/PHONE NUMBER: \_\_\_\_\_  
\_\_\_\_\_

## TYPE ITEMS RECYCLED:

_____ Concrete without rebar	_____ Concrete with rebar
_____ Scrap Metals	_____ Wood
_____ Roofing Materials	_____ Brick
_____ Asphalt	
_____ Other: Specify _____	

TONNAGE OF ITEMS RECYCLED: \_\_\_\_\_ TONS

## TYPE ITEMS NOT RECYCLED:

_____ Concrete without rebar	_____ Concrete with rebar
_____ Scrap Metals	_____ Wood
_____ Roofing Materials	_____ Brick
_____ Asphalt	
_____ Other: Specify _____	

CONTINUED ON THE BACK  
C&D DEBRIS RECYCLING AND REPORTING FORM (CONT'D)

**REASONS ITEMS WERE NOT RECYCLED:**

\_\_\_\_\_ No market for the items  
\_\_\_\_\_ No local vendors to recycle the materials  
\_\_\_\_\_ Not economically feasible: Specify: \_\_\_\_\_  
\_\_\_\_\_ Other: Specify: \_\_\_\_\_

**PROVIDE NAME OF COMPANY, POINT-OF-CONTACT, AND PHONE NUMBER OF SOURCE BY WHICH RECYCLING AN ITEM(S) WERE ATTEMPTED:**

Company Name: \_\_\_\_\_  
Point of Contact: \_\_\_\_\_  
Phone Number: \_\_\_\_\_

**C&D ITEMS DISPOSED OF BY LANDFILL: \_\_\_\_\_ TONS**

**C&D ITEMS DISPOSED OF THROUGH REGULAR INCINERATION: \_\_\_\_\_ TONS**

**ITEMS DISPOSED OF BY WASTE-TO-ENERGY INCINERATION: \_\_\_\_\_ TONS**

\_\_\_\_\_  
**CONTRACTOR SIGNATURE**

\_\_\_\_\_  
**DATE**

**NOTE: ELECTRONIC SIGNATURE ACCEPTABLE**

SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS**ATTACHMENT 2**Contractor Hazardous Material Worksheet

**FOR ASSISTANCE WITH THIS WORKSHEET CONTACT LAFB HAZMART AT 757-764-3837**  
**CORRESPONDING MATERIAL SAFETY DATA SHEET MUST BE ATTACHED.**

**CONTRACTOR INFORMATION**

Prime contractor name:  
Subcontractor name (if applicable):  
Project Manager POC name:  
Contracting Office POC:  
Contract #:  
Project #:  
Project title:  
Project date range:                      through                      (mm-dd-yyyy)

**MATERIAL INFORMATION**

Part number (from MSDS) or National Stock Number:  
Noun/Common Name:  
Type of Container (ex - can, bucket, box):  
Size (ex - 1 gal, 5 gal, 1qt, 500 mL, tank):  
Unit of Issue (ex - each, box/12, case/24):

**DRAW INFORMATION**

Estimated amount of this material to be used for duration of contract\*:

*\* At project completion, submittal summarizing actual usage is required*

**TASK INFORMATION**

Task Description (describe what it is used for):

**LOCATION INFORMATION**

Will the process be performed in: (check all applicable locations)

☐ A facility, ☐ aircraft, ☐ equipment, ☐ manhole, ☐ other structure? ☐ Outdoors?

Is material going to be used in an area occupied by USAF military or civilians? ☐ Yes ☐ No

What is the storage location of unused materials?

Will respirators be worn?                      Yes                      No

Will a ventilation system be used?                      Yes                      No

**REMARKS** (provide any additional comments or information)

**Contractor Point of Contact**

Requestor's Name:  
Address:  
Phone Number:

Title:  
  
Date:

**To Be Completed by USAF Personnel Only**

EMIS Shop Code: \_\_\_\_\_

BEE: \_\_\_\_ Recommend Approval \_\_\_\_ Recommend Disapproval: Comments:

SE: \_\_\_\_ Recommend Approval \_\_\_\_ Recommend Disapproval: Comments:

CEV: \_\_\_\_ Approve \_\_\_\_ Disapprove: Comments:

HAZMART: \_\_\_\_ Concur \_\_\_\_ Nonconcur: Comments:

SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS**ATTACHMENT 3****CONTRACTOR'S MONTHLY REPORT FOR HAZMATS**

Contractor:

Shop Code:

Contract#:

Location:

The following information is required for tracking of hazardous materials on Langley AFB. For contracts exceeding six months, this form is required to be filled out on a monthly basis and returned to the Government project Quality Assurance Personnel (QAP). For contracts that are less than six months, this form is required at the beginning and at the completion of the work. The QAP will provide a copy to the HAZMART Pharmacy located in Bldg 330. This information is required to comply with State, Federal, local, and Air Force laws and regulations.

MATERIAL NAME	MANUFACTURER	NSN/PART #	START BALANCE	AMOUNT USED

Use additional sheets if required.

Contractor Name: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_

Government QAP: \_\_\_\_\_

Signature: \_\_\_\_\_

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SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS**ATTACHMENT 4****CONTRACT SUBMITTAL AND CONTRACTOR REPORTING FORM**

## Comprehensive Procurement Guidelines

(This chart is not intended to replace the EPA guidelines found at <http://www.epa.gov/cpg/products.htm>). It is the contractor's responsibility to stay apprised of any new additions to these guidelines. )

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
<b><u>VEHICULAR PRODUCTS</u></b>				
Engine coolants - antifreeze				
Rebuilt vehicular parts				
Re-refined lubricating oils -including motor oil				
Retread tires				
<b><u>CONSTRUCTION PRODUCTS</u></b>				
Building insulation products				
Carpet (Polyester)				
Carpet cushion				
Cement and concrete containing coal fly ash, ground granulated blast furnace slag, cenospheres, or silica fume				
Consolidated and reprocessed latex paint				
Floor tiles				
Flowable fill				

SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
Laminated paperboard				
Modular threshold ramps				
Nonpressure pipe				
Patio blocks				
Railroad grade crossing surfaces				
Roofing materials				
Shower and restroom dividers and partitions				
Structural fiberboard				
<b><u>LANDSCAPING PRODUCTS</u></b>				
Compost made from yard trimmings or food waste				
Garden and soaker hoses				
Hydraulic mulch				
Lawn and garden edging				
Plastic lumber landscaping timbers and posts				
<b><u>NON-PAPER OFFICE PRODUCTS</u></b>				
Binders				



SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
<b><u>NON-PAPER-OFFICE PRODUCTS</u></b> (cont)				
Clipboards				
Clip Portfolios				
File folders				
Presentation Folders				
Office Furniture				
Office recycling containers				
Office waste receptacles				
Plastic desktop accessories				
Plastic envelopes				
Plastic trash bags				
Printer ribbons				
Toner cartridges				
<b><u>PAPER AND PAPER PRODUCTS</u></b>				
Commercial/industrial sanitary tissue products				
Miscellaneous papers				

SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
Newsprint				
Paperboard and packaging products				
Printing and writing papers				
<b><u>PARK and RECREATION PRODUCTS</u></b>				
Park benches and picnic tables				
Plastic fencing				
Playground equipment				
Playground surfaces				
Running tracks				
<b><u>TRANSPORTATION PRODUCTS</u></b>				
Channelizers				
Delineators				
Flexible delineators				
Parking stops				
Traffic barricades				
Traffic cones				

SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
<u>MISCELLANEOUS PRODUCTS</u>				
Awards and plaques				
Bike Racks				
Blasting grit				
Industrial drums				
Manual-grade strapping				
Mats				
Pallets				
Signage				
Sorbents				

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**SECTION 01120 – ENVIRONMENTAL SPECIAL CONDITIONS****ATTACHMENT 5****RECOVERED MATERIALS DETERMINATION FORM**

This form is to be completed by the procurement originator for all purchases requesting an exemption from the Affirmative Procurement Program for Recovered Materials being procured. For questions on whether the product is "EPA designated" or what the required recycled content is, refer to the product descriptions on EPA's website at <http://www.epa.gov/cpg/products.htm>. This form is not required for construction item purchases less than \$2,000, or for other purchases less than \$2,500.

Procurement Request/Project No. \_\_\_\_\_

**EPA Designated Eight Product Category Items****Category 1 Paper and Paper Products**

<input type="checkbox"/> Commercial/industrial sanitary tissue products	<input type="checkbox"/> Paperboard/packing products <input type="checkbox"/> Miscellaneous papers	<input type="checkbox"/> Printing and writing papers <input type="checkbox"/> Newsprint
--	---	--

**Category 2 Non-Paper Office Products**

<input type="checkbox"/> Binders (paper, plastic)	<input type="checkbox"/> Plastic trash bags	<input type="checkbox"/> Plastic presentation folders
<input type="checkbox"/> Plastic envelopes	<input type="checkbox"/> Office waste receptacles	<input type="checkbox"/> Plastic clip portfolios
<input type="checkbox"/> Office recycling containers	<input type="checkbox"/> Plastic file folders	<input type="checkbox"/> Solid plastic binders
<input type="checkbox"/> Office furniture	<input type="checkbox"/> Plastic desktop accessories	<input type="checkbox"/> Printer ribbons
	<input type="checkbox"/> Plastic clipboards	<input type="checkbox"/> Toner Cartridges

**Category 3 Park and Recreation Products**

<input type="checkbox"/> Park benches and picnic tables	<input type="checkbox"/> Running tracks	<input type="checkbox"/> Playground equipment
	<input type="checkbox"/> Playground surfaces	<input type="checkbox"/> Plastic fencing

**Category 4 Transportation Products**

<input type="checkbox"/> Traffic barricades	<input type="checkbox"/> Delineators	<input type="checkbox"/> Traffic Cones
<input type="checkbox"/> Parking Stops	<input type="checkbox"/> Flexible delineators	<input type="checkbox"/> Channelizers

**Category 5 Vehicular Products**

<input type="checkbox"/> Engine Coolants	<input type="checkbox"/> Retread tires	<input type="checkbox"/> Re-refined lubricating oils	<input type="checkbox"/> Rebuilt vehicular parts
--	--	--	--

**Category 6 Landscaping Products**

<input type="checkbox"/> Garden and soaker hoses	<input type="checkbox"/> Hydraulic mulch	<input type="checkbox"/> Landscaping timbers and posts (plastic lumber)
<input type="checkbox"/> Yard trimmings compost	<input type="checkbox"/> Lawn and garden edging	<input type="checkbox"/> Food waste compost

**Category 7 Construction Products**

<input type="checkbox"/> Consolidated and reprocessed latex paint	<input type="checkbox"/> Railroad grade crossing and surfaces	<input type="checkbox"/> Structural fiberboard
<input type="checkbox"/> Cement and concrete containing coal fly ash, ground granulated blast furnace slag, cenospheres, or silica fume	<input type="checkbox"/> Building insulation	<input type="checkbox"/> Carpet (polyester)
<input type="checkbox"/> Roofing materials	<input type="checkbox"/> Shower and restroom dividers	<input type="checkbox"/> Carpet cushion
	<input type="checkbox"/> Laminated paperboard	<input type="checkbox"/> Floor tiles
	<input type="checkbox"/> Modular threshold ramps	<input type="checkbox"/> Patio blocks
	<input type="checkbox"/> Nonpressure pipe	<input type="checkbox"/> Flowable fill

**Category 8 Miscellaneous Products**

<input type="checkbox"/> Manual-grade strapping	<input type="checkbox"/> Mats	<input type="checkbox"/> Pallets	<input type="checkbox"/> Industrial drums
<input type="checkbox"/> Bike racks	<input type="checkbox"/> Awards and plaques	<input type="checkbox"/> Signage	
<input type="checkbox"/> Blasting grit	<input type="checkbox"/> Sorbents		

**EXEMPTION CERTIFICATION**

\_\_\_ The following EPA designated guideline item is included in the specifications for the project however, compliance with EPA standards is not attainable.

Item: \_\_\_\_\_

I have determined that the EPA guidelines were considered and determined inapplicable, based on the following:

\_\_\_ Item is not available within a reasonable period of time.

(Need date: \_\_\_\_\_ Date available: \_\_\_\_\_)

\_\_\_ Item fails to meet a performance standard in the specifications.  
Specifically, \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_ Item was only available at an unreasonable price (i.e., recycled item cost more than non-recycled item).

Price of recycled item: \_\_\_\_\_

Price of non-recycled item: \_\_\_\_\_

\_\_\_ Item is not available from 2 or more sources.

*Market research was performed by calling \_\_\_\_\_ (insert number)  
vendors, but only \_\_\_\_\_ (enter name) was able to supply the item.*

This determination is made in accordance with FAR 23.405(c).

\_\_\_\_\_  
Procurement Originator/Contractor

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of GPC Approving Official (if GPC used)  
or Project Manager/Supervisor/Flight Chief or Deputy for  
all other type purchases

\_\_\_\_\_  
Date

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX BB

Specification Sections 01 11 00 Summary of Work and  
01 12 00 Asset Management Special Conditions

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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## F-22 Add/Alter Hangar Bay LO/CR Facility

## SECTION 01 11 00

SUMMARY OF WORK  
01/08

## PART 1 GENERAL

## 1.1 DEFINITIONS

NOT USED.

## 1.2 WORK COVERED BY CONTRACT DOCUMENTS

## 1.2.1 Project Description

The work includes construction of a LO/CR paint spray hangar bay addition to Building 361 for the F-22 Aircraft, ancillary spaces and incidental related work.

## 1.2.2 Location

The work shall be located at the Langley Air Force Base, Virginia, approximately as indicated. The exact location will be shown by the Contracting Officer.

## 1.3 OCCUPANCY OF PREMISES

Existing Building 361 will be occupied during performance of work under this Contract. Occupancy notifications will be posted in a prominent location in the work area.

Before work is started, the Contractor shall arrange with the Contracting Officer a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways.

## 1.4 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

- a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.
- b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

## 1.5 EXCAVATION

Notify the Contracting Officer at least [48 hours] [15 days] prior to starting excavation work.

## 1.6 SALVAGE MATERIAL AND EQUIPMENT

Items designated by the Contracting Officer to be salvaged shall remain the property of the Government.

## F-22 Add/Alter Hangar Bay LO/CR Facility

The salvaged property shall be segregated, itemized, delivered, and off-loaded at the Government designated storage area located within 5 miles of the construction site.

Contractor shall maintain property control records for material or equipment designated as salvage. Contractor's system of property control may be used if approved by the Contracting Officer. Contractor shall be responsible for storage and protection of salvaged materials and equipment until disposition by the Contracting Officer.

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

1. ASSET MANAGEMENT: All work is to be performed in a manner that prevents pollution, protects the environment and conserves natural resources.

1.1 WASTE DISPOSAL:

1.1.1. SOLID WASTE DISPOSAL.

1.1.1.1. Compliance With Regulations All waste materials generated by any work under this contract performed on a Government installation shall be handled, transported, stored, recycled, and disposed of by the Contractor and by his/her subcontractors at any time in accordance with these specifications, all applicable Federal, state, or local laws, ordinances, regulations, court orders, or other types of rules or rulings having the same effect of law. These include but are not limited to the Resource Conservation and Recovery Act (RCRA) (40 CFR 260-270); Federal Water Pollution Control Act, as amended (33 USC Sec 1251 ET SEQ); The Clean Air Act, as amended (42 USC Sec 1857 ET SEQ); The Endangered Species Act, as amended (16 USC Sec 1531, ET SEQ); The Toxic Substances Control Act, as amended (15 USC Sec 2601, ET SEQ); The Solid Waste Disposal Act, as amended (42 USC 6901 ET SEQ); the Archaeological and Historic Preservation Act, as amended (16 USC Sec 469, ET SEQ), and the Virginia Solid Waste Management Regulations (9VAC 20-80).

The Contractor shall collect all solid wastes generated during the performance of the contract in a container/area provided by the Contractor and approved by the Contracting Officer. The Contractor shall provide appropriate containers for the collection and segregation of solid wastes, recyclables, and C&D debris generated directly and indirectly by work under this Contract. The Contractor is prohibited from using base dumpsters or other government owned/leased waste receptacles for the disposal of any solid wastes. All solid wastes shall be reclaimed, recycled, or disposed of prior to completion of work on LAFB.

As proof of proper disposition of solid wastes, the Contractor shall provide legible weight receipts for solid waste disposed and materials recycled bearing the name, address, and phone number of the receiving facilities for every load of materials delivered. The weight ticket shall detail the type of material, weight of the material in pounds or tons, the date of the transaction, and a signature from a representative of the receiving facility. Receipts shall be submitted to the Contracting Officer within ten (10) calendar days after the transaction.

Under no circumstances will any solid waste or hazardous materials be left at LAFB at the end of the project. Before the project is turned over to the government, the Contractor will remove all solid wastes and hazardous materials from the installation. Those items include but are not limited to dirt piles, concrete piles, asphalt piles, and rubbish piles. No materials will be left for the future use of the government UNLESS instructed to do so in writing by the government. This is to include the before mentioned items and also regular or touch-up paint, plaster, solvents, etc. If it is determined that the Contractor left materials behind, services may be terminated and/or a penalty payment to include the cost of disposal of the material by the government may be withheld from the project payment.

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

NOTE: Hazardous materials are different from hazardous wastes so be careful not to confuse the two. For hazardous wastes, they will not be removed from the installation without the 633 CES Hazardous Waste Managers signing the Hazardous Waste Manifest. The LAFB Hazardous Waste Managers can be contacted at 757-764-1132/1133 if needed.

#### 1.1.1.2. CONSTRUCTION/DEMOLITION DEBRIS DIVERSION:

As good stewards of the environment, the government is committed to diverting its waste away from landfills to the greatest extent possible. This can be done through recycling, reusing (when directed by the government), and donating construction and demolition debris materials. The Contractor shall recycle all construction/demolition debris to the maximum extent possible. The Contractor shall make every effort to recycle materials such as but not limited to concrete (including concrete with rebar), brick, asphalt, all metals, wood, roofing materials, wallboard, ceiling tiles, etc. With prior coordination through the CO and 633 CES/CEA, the Contractor may take scrap metals to the Langley AFB scrap metal yard for recycling. The following are some suggested local sites for recycling construction and demolition debris:

Local Sources of Recycling				
Company	Address	City	Phone	Acceptable Items
Tidewater Fibre	5602 Chestnut Ave	Newport News	247-5766	paper, cardboard, plastics, aluminum, glass, tin cans
Old Dominion Recycling	1618 W. Pembroke Ave.	Hampton	723-2942	Aluminum, copper, steel, iron, metals, paper, tires
Butler Paper	324 Newport St	Suffolk	539-2351	Industrial & Commercial Paper Recycling
Dubin Metals	2409 Bowdens Ferry Rd	Norfolk	622-3970	Scrap Metals, Copper, Brass, Batteries, Radiators, Aluminum
Gutterman Iron & Metal	1206 E. Brambleton Ave.	Norfolk	627-1095	Scrap Brass, Copper & Aluminum
Sims Metal	2116 George Washington Memorial Hwy	Tabb	599-4940	Steel, aluminum, brass, copper, stainless steel, radiators
Waterway Marine Terminal	1401 Precon Drive	Chesapeake	333-3427	all C & D materials i.e. concrete, concrete w/rebar, lumber, asphalt
Waterway Materials Corp	1401 Precon Drive	Chesapeake	545-0004	Concrete, concrete w/rebar, brick, block, asphalt
K.F. Wilson	2972 N. Armistead Ave	Hampton	865-7182	all C & D materials i.e. concrete, concrete w/rebar, lumber, asphalt
CrushCon Aggregates	100 North Park Lane	Hampton	723-1131	Concrete, concrete w/rebar

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

1.1.1.2.1 RECYCLING AND DISPOSAL REPORTING: The Contractor shall report on a quarterly basis the tonnage of the items recycled and the amounts disposed of by landfill and amounts disposed of by regular or waste-to-energy incineration to the Project Manager, the Contracting Officer, and 633 CES Asset Management Flight (633 CES/CEA) by the 5<sup>th</sup> day of each quarter (Jan, Apr, Jul, Oct) during the period of performance. This report will be for the previous quarter. The report shall list the title of the project, the project number, the Contractor's company name and point-of-contact, phone number, the type items (i.e. concrete, concrete with rebar, asphalt, brick, scrap metals, wood, wallboard, etc) and the tonnage of those items recycled. For all items that could not be recycled, the Contractor will provide a brief reason as to why the items could not be recycled.

For items disposed of, one total tonnage can be given for items landfilled and one total tonnage for items incinerated (specify waste incinerator or waste-to-energy incinerator) instead of reporting disposal figures for the various items. For items that cannot be accurately measured, estimates will be sufficient. Use the form at Attachment 1 (Construction/Demolition Debris Recycling and Reporting) to report this information to the Contracting Officer, Project Manager, and to 633 CES/CEAN.

To send it to 633 CES/CEAN, email it to [Carmichael.Patton@langley.af.mil](mailto:Carmichael.Patton@langley.af.mil) or mail it to:

633 CES/CEAN  
Attn: Pollution Prevention Mgr  
Bldg 328, Room 253  
37 Sweeney Blvd  
Langley AFB VA 23665

1.1.1.3 Contain Loose Debris. Loose debris on trucks leaving the site shall be loaded in a manner that shall prevent dropping of materials on streets and conform to local ordinances/laws. Fasten a suitable cover, such as a tarpaulin, over the load before entering surrounding streets.

1.1.1.4 Trip Tickets. Contractor shall submit all trip tickets from the landfill facility, incinerators, and recycling companies to show all debris is being landfilled, incinerated, or recycled in accordance with all Federal requirements and in an approved location. These trip tickets will be submitted to the Contracting Officer who will in turn give them to the Project Manager.

1.1.2. PETROLEUM CONTAMINATED WASTE:

1.1.2.1. Contaminated Absorbents. All petroleum spills must be cleaned up using absorbent materials. Spills caused by the Contractor will be the Contractor's responsibility to containerize and dispose of the contaminated absorbent material. Spills caused by the government will be the responsibility of the government. Contact the base hazardous waste Contractor, Chugach at 225-5808 or 225-5809 to arrange for pick-up.

1.1.2.2. Waste Soil. Suspect soil must be tested to determine if it contains any contaminants prior to relocating it. Testing and disposal of soil shall follow Virginia Solid Waste Management

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

Regulations 9VAC-20-80-700 (soil contaminated with petroleum products). Testing shall include: Total Petroleum Hydrocarbon (TPH), Total Organic Halogens (TOX), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX), and Toxicity Characteristic Leaching Procedures (TCLP). If test results determine “other than clean”, the material will have to be transported to an appropriate landfill or processing center based on the contaminants identified. Contaminated soils, in sludge or slurry form, shall be containerized and managed as either hazardous waste or non-regulated waste, depending on what contaminate was spilled. The containerized contaminated soil shall be the responsibility of the Contractor to dispose of such. CEA must review the sample results and sign all hazardous/non hazardous waste manifests prior to disposal. Contact 633 CES/CEANC Hazardous Waste Program Managers for additional information.

NOTE: UNDER NO CIRCUMSTANCES will soil, clean or contaminated, from Langley AFB be delivered to or donated to off-base sources (other than an appropriate landfill or processing center based on the contaminants identified ) for use. Soils donated to off-base entities for use will be the sole liability and responsibility of the Contractor.

#### 1.1.3. UNIVERSAL WASTE:

1.1.3.1. Fluorescent Lamps. The Contractor shall use environmentally-friendly green tip fluorescent lamps during lamp replacement. Upon removal of old Sylvania lamps and high intensity bulbs, the Contractor will box the lamps and manage them as universal waste. Other lamps (i.e. GE and Phillips) may be disposed directly in to regular trash. Contact the base hazardous waste Contractor at 225-5808 or 225-5809 to arrange for pick-up, except in cases where lamp replacement is part of the contract. Lamps will be properly disposed of by the Contractor with waste manifest being signed by 633 CES/CEANC Hazardous Waste Program Managers.

#### 1.1.4. HAZARDOUS WASTE.

1.1.4.1. SITE MANAGEMENT. All material containers must be closed when not in use. Materials are to be covered as protection from weather. Each container is to be properly labeled. Do not store hazardous materials near storm drains. Upon completion of this project the Contractor shall remove all hazardous materials and hazardous waste (for associated manifest requirements see paragraph 1.1.4.2.)

1.1.4.2. MANIFESTS. 633 CES/CEANC will review all lab analysis or MSDS of wastes prior to signing manifests. All hazardous waste manifests must be signed by 633 CES/CEANC prior to removal of such waste from the base. The generator copy of the manifest must be returned to 633 CES/CEANC, 37 Sweeney Blvd, LAFB VA 23665.

1.2 FUEL, SEWAGE, AND OTHER SPILLS: In the event of a fuel, sewage, and other toxic spillage during the performance of this contract, the Contractor shall be responsible for its containment, clean up, and related disposal costs and will notify 633 CES/CEANC immediately. The operator shall have sufficient spill response supplies readily available on the pumping vehicle and/or at the site to contain any spillage. In the event of a Contractor-related release, the Contractor shall immediately notify the Asset Management Office and the Contracting Officer

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

and take appropriate actions to correct its cause and prevent future occurrences. If the federal, state, or local authorities assess any monetary fine, penalty, or assessment related to the release of any substance by the Contractor, his/her employees, or agents during the performance of this contract, the Contractor shall be solely liable for its payment, authorizes the United States Air Force to withhold such from payment and otherwise indemnify and hold the United States Air Force harmless.

### 1.3 ASBESTOS OR LEAD BASED PAINT

1.3.1. ASBESTOS PRESENCE: If asbestos not previously known to exist is exposed, the Contractor shall cease work in the affected area and notify the Contracting Officer.

1.3.1.1. ABATEMENT PLAN: Abatement plans are to include but not limited to the description of how abatement is to be accomplished, required notifications, required licensing, employee safety requirements, and air sampling.

1.3.1.2. ASBESTOS ABATEMENT OR REMOVAL NOTIFICATION: Contractor is responsible for disposal of Asbestos debris. Contractor is subject to OSHA, EPA and Commonwealth of Virginia compliance and inspection for asbestos removal. Contractor must perform asbestos removal work in accordance with these specifications and EPA National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for asbestos and any subsequent updates thereto. This includes state and EPA Region 3 notifications that shall be accomplished at least 20 days prior to starting any asbestos abatement or removal. A copy of the notification shall be submitted to the Contracting Officer.

1.3.1.3. ASBESTOS MANIFESTS: All asbestos waste manifests shall be signed by 633 CES/CEA (37 Sweeney Blvd) prior to removal of such waste from the base. A copy of the completed manifest (signed by the receiving landfill) shall be submitted to 633 CES/CEANC.

1.3.2. LEAD BASED PAINT PRESENCE: If lead based paint not previously known to exist is exposed, the Contractor shall cease work in the affected area and notify the Contracting Officer.

1.3.2.1. ABATEMENT PLAN: Abatement plans are to include but not limited to the description of how abatement is to be accomplished, required licensing, employee safety requirements, and air sampling.

1.3.2.2. LEAD BASED PAINT DISPOSAL. Once removed, lead based paint shall be disposed of as hazardous waste. Disposal of lead debris containers is the responsibility of the Contractor. Lead contaminated debris must be sampled to determine the level of lead. The analysis will determine waste management procedures. 633 CES/CEANC will inform the Contractor on management procedures. If wastes are determined to be hazardous by regulatory criteria, the containers cannot leave the installation until a completed manifest is reviewed and signed by 633 CES/CEANC. The Contractor must contact Chugach at 225-5808/09 to store full drums of lead contaminated waste at the < 90 day site located at 510 Poplar Rd. The drum/s must be in good condition, labeled properly and closed. The Contractor has less than 90 days of storage on base before the containers must leave the installation.

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS**1.4 AIR QUALITY**

1.4.1. **VOLATILE ORGANIC COMPOUNDS:** All coatings and solvents used in the performance of this contract shall meet the required performance specifications and shall not exceed the volatile organic compound limits of the Air Pollution Control Districts where they are used.

1.4.2. **DUST:** Mitigation of fugitive dust emissions shall be accomplished in accordance with 9 VAC5-40-90, Standards for Fugitive Dust/Emissions.

1.4.3. **GENERATORS:** To meet permit requirements, submit required data (Kilowatt (KW) rating) for each emergency generator installed to 633 CES/CEANC.

1.4.5. **OZONE DEPLETING SUSTANCES (ODS)**

Contracts may not include any specification, standard, drawing, or other document that requires the use of a Class I ODS in the design, manufacture, test, operation or maintenance of any system, subsystem, item, component, or process. Contracts may not require the delivery of any items of supply that contains a Class I ODS or any service that includes the use of a Class I ODS.

**1.5 WATER QUALITY:**

1.5.1. **EROSION AND SEDIMENT CONTROL:** All construction operations shall comply with the requirements of the Virginia Erosion and Sediment Control Act. An Erosion and Sediment Control Plan shall be prepared prior to initiating groundbreaking activities. A copy of the E&SC Plan shall be forwarded to 633 CES/CEANC (Water Program Manager). Hay bales shall not be used for erosion control and inlet protection from storm water run-off. The Contractor shall submit alternate methods of protection to the Contracting Officer at the preconstruction conference for review and approval. The Contracting Officer will notify the Contractor of his/her decision prior to issuance of Notice to Proceed (NTP).

1.5.2. **STORMWATER PERMIT.** If over one (1) acre is to be disturbed as part of the project, the contractor shall obtain a Stormwater General Construction Permit from the Virginia Department of Conservation and Recreation (VDCR). A stormwater pollution prevention plan (SWPPP) shall be prepared to support the stormwater permit; a copy of the SWPPP shall also be forwarded to 633 CES/CEANC (Water Program Manager). The Contractor is solely responsible for obtaining, funding, and complying with the terms of the permit. A copy of the permit shall be forwarded to 633 CES/CEANC (Water Program Manager).

**1.6. HAZARDOUS MATERIALS MANAGEMENT**

1.6.1. **Hazardous Materials Usage and Reporting:** In compliance with AFI 32-7086 dated 1 Nov 2004 and AFI 32-7086 ACC Sup 1, all Contractors are required to report the usage of all hazardous materials to the government for all projects and contracts including service contracts executed on LAFB. In accordance with FAR Clause 52.223-3, each offeror (Contractor) must provide the Contracting Office with a list of proposed HAZMAT that it plans to use on the



SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

installation during the performance of the contract. In accordance with AFFARS Clause 5352.223-9303, Contractors must obtain Air Force authorization prior to using HAZMAT on an Air Force installation, and must report usage data to the HAZMART.

Hazardous materials are any substance defined by OSHA as a hazardous substance requiring a Material Safety Data Sheet (MSDS). Hazardous materials that need to be reported include but are not limited to chemicals, paints, thinners, sealing compounds, strippers, glues, solvents, all petroleum products including oils, hydraulic fluids, and fuels stored on-site (fuels in vehicles are exempt), pesticides, adhesives, acids, flammables, corrosives, oxidizers, compressed gases (such as but not limited to oxygen, acetylene, propane, flammable and non-flammable gases), all aerosols, and all materials containing hazardous substances.

The Contractor shall request the proposed usage of all Hazardous Materials by completing the “Contractor Hazardous Material Worksheet” at Attachment 2 (Contractor Hazardous Material Worksheet) for each hazardous material and shall submit a copy of the Material Safety Data Sheet (MSDS) for each item to the Contracting Officer (CO) prior to bringing the items on the installation. The Contractor shall submit to the CO the information for each item within 10 days after award of the contract or project and/or not less than fourteen calendar days prior to bringing the items on the installation. For short notice contracts or projects, the Contractor will submit this information to the CO as soon as possible. An electronic version of the Contractor Hazardous Material Worksheet can be obtained through the Project Manager or 633 CES/CEAN.

The CO will immediately provide this information to the Project Manager who will in turn provide it to 633 CES/CEAN immediately.

After the project starts, monthly usage information will be provided to the CO who will in turn provide this information to the Project Manager who will in turn provide it to 633 CES/CEAN. Attachment 3 (Monthly Report for HAZMAT) of this section will be used to report monthly usage. For contracts/projects exceeding six months, this form is required to be filled out on a monthly basis. For contracts less than six months, this form is required at the beginning and at the completion of work.

If there are any questions on how to fill out the Contractor Hazardous Material Worksheet or the monthly report, contact the LAFB HAZMART at 757-764-3837 Monday thru Friday between the hours of 0730-1630 or visit them at:

633 LRS/HAZMART  
Bldg 330  
23 Sweeney Blvd  
Langley AFB VA 23665

1.6.2. Hazardous Materials Management Process (HMMP): The LAFB HMMP team will meet on a weekly basis or an as-needed basis to review the Contractor Hazardous Material Worksheets and MSDSs to ensure there are no concerns with the chemicals being used and/or stored on the installation. If there are concerns about any chemicals and if it is determined that the Contractor plans to use an extremely hazardous chemical on LAFB, the HMMP team will notify the Project Manager and the Contracting Officer (CO) who will in-turn notify the Contractor of LAFBs

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concern. The Contractor will not bring any extremely hazardous chemicals on LAFB or any other chemicals that the HMMP team determines cannot be used on Langley. The HMMP team will also notify the Project Manager if all hazardous materials are authorized for use.

If the Contractor requires additional hazardous materials not previously submitted for approval, they shall submit the request as stated above seven days prior to bringing the item on the base.

NOTE: If it is determined at any time that hazardous materials are on site that were not reported in advance, the CO will be notified and the project can be stopped until the materials are submitted as stated above.

1.6.3. Hazardous Material Storage: Hazardous materials will be managed properly at all times while on LAFB. This means containers will be in good condition and will be properly labeled with the contents and hazard class (flammable, corrosive, oxidizer, etc) at all times. Containers will be closed at all times when not in use, hazardous materials will be kept under cover to protect them from the elements and to prevent stormwater runoff contamination, and tanks and 55-gallon liquid drums will have secondary containment. Gas cylinders will be maintained in the upright position with caps on and will be secured with chains and locks to prevent tampering and to prevent them from falling over. Gas storage areas will have signs indicating what type gases are stored in the area (ie flammable, oxidizer, non-flammable, etc). NO SMOKING signs will be posted in all hazardous materials storage areas. In addition, all hazardous materials will be segregated in storage according to compatibility (ie flammables will not be stored with corrosives, corrosives will not be stored with oxidizers, flammable gases will not be stored with flammable liquids, etc). LAFB is subject to inspections at any time from outside agencies (EPA, Virginia Dept of Asset Management Quality, and OSHA) and any violations by the Contractor will be the responsibility of the Contractor and any fines associated with the violations will be resolved at the Contractor's expense.

#### 1.7 USE OF RECYCLED-CONTENT PRODUCTS: (GREEN PROCUREMENT):

Whenever the potential for use of non-recycled content products exists during the construction stage of the project, the Contractor shall incorporate in this project, as a substitute, recycled-content products that are listed and identified in the Asset Management Protection Agency (EPA) Comprehensive Procurement Guidelines (CPG) for recycled-content products. The Contractor shall use recycled-content products as required by EPA and other governmental agencies and Federal Acquisition Regulation (FAR) clauses.

It is mandated by Executive Order 13101 (Greening the Government through Waste Prevention, Recycling, and Federal Acquisition) and Section 6002 of the Resource Conservation and Recovery Act (RCRA) that the Federal Government use recycled-content products in the construction and/or renovation of facilities. It is the intent of the Government to comply with the Asset Management Protection Agency (EPA) requirement 100% of the time and use as many of the applicable listed recycled-content products as feasible and economically practical. The Contractor shall consider this a standard requirement for all aspects of the project construction.

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The recycled-content products listed in the CPG can be found in the EPA website at [www.epa.gov/cpg/products.htm](http://www.epa.gov/cpg/products.htm). These products are also listed at Attachment 4 (Contract Submittal and Contractor Reporting Form). This list is subject to change at any time so it is the Contractor's responsibility to be aware of any updates or additions.

Such products shall also comply with the requirements of the EPA Recovered Materials Advisory Notice (RMAN). The RMANs recommend recycled-content ranges for CPG products based on current information on commercially available recycled-content products. The recommended recovered materials content percentage can be obtained by clicking on the product on the website.

1.7.1. Green Procurement Forms Before starting the project, the Contractor shall complete Attachment 4 indicating the items he plans to use. The Contractor will provide this to the Contracting Officer and the Project Manager. Then during the accomplishment of the project construction, the Contractor shall complete the form again. At this time, the Contractor shall indicate the use and non-use of products that are contained in the CPG and will list the recycled-content percentage for the applicable item. In each instance where a recycled-content construction product is not used, the Contractor shall provide to the Contracting Officer (or his/her designated representative) and the Project Manager a completed Exemption Form, Attachment 5 (Recovered Materials Determination Form).

The Contractor shall complete this form for all items for which he or she desires an exemption from the Green Procurement Program for Recovered Materials that are being procured. Exemptions can only be taken if (1) the item is not available within a reasonable period of time (2) item fails to meet a performance standard in the specifications and (3) the item was only available at an unreasonable price i.e., the recycled-content product costs more than the non-recycled content product. The fourth reason on the Recovered Materials Determination Form, (4) the item is not available from 2 or more sources, does not apply to construction/renovation Contractors as the Government will not specify where you can get your materials from. Specific reasons why an exemption is taken will be specified on the form and documentation supporting this reason will be provided and attached.

The Contractor will sign the form as the "Procurement Originator" and the completed form will also be signed by the 633 CES Programs Flight Chief or Deputy Flight Chief, 633 CES/CEP. These forms will be kept in the project folder indefinitely.

## 1.8 SOIL SUPPORT PROGRAM (SSP) ACCEPTABILITY

The soils obtained from off-base sources shall meet the criteria outlined below. The soils generated during construction project excavation will be collectively referred to as project (soil) media. Soil media is not inherently waste-like, but it may contain waste-like materials, including contaminants associated with the site. Given the base history of operations, the Contractor must make a determination of whether the soil is contaminated. If the media is determined to be contaminated, then a hazardous waste determination must be made. Standards for testing are described below. The contaminated media will be managed as a solid waste and removed from

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

base. If the media is determined to be uncontaminated and not waste-like, then it may be disposed on site in an Asset Management sound manner.

1.8.1. Clean Soil. Projects requiring clean soil, including but not limited to top soil and backfill materials, to be brought onto Langley AFB or relocated within base property must meet minimum standards based on results of physical (geotechnical) and chemical testing. All materials will meet physical (geotechnical) specifications appropriate for the type of project being accomplished and are typically identified elsewhere in the project specifications. The intent of this section is to prevent contamination from borrowed sources (i.e. planned excavation) and define clean soil based on chemical specifications. Levels of chemical contamination will be determined to ensure borrow soils may be used for the current and future use of the project location. The Contractor shall implement a plan and confirm the proposed borrow soils meet clean soil requirements. The plan should incorporate borrow source information, sampling data, and testing results. As a minimum, the Contractor shall meet the following standards:

1.8.2. Borrow Source. The Contractor shall provide detailed borrow source information (e.g., location, owner, operator, past and current land use, previous chemical testing results) at the point of planned excavation to 633 CES/CEA to determine chemical testing requirements. The Contractor shall also submit a certification stating the materials contain no asbestos, no gross contamination have been discerned by visual or olfactory observations, and no spills of a listed hazardous waste (40 CFR 261) have occurred at the borrow site. If previous chemical testing results exist and are provided, 633 CES/CEA will evaluate those results to determine if they are sufficient and the proposed borrow soils meet clean soil requirements. If testing is incomplete, 633 CES/CEA will review borrow source information to determine chemical sample requirements.

1.8.2.1. On-base Soil Sources. Unless otherwise provided in the contract, the Contractor shall bear all expenses of developing the source. For the site where soil is reclaimed from government land, the Contractor may be required to perform final grade and seeding according to project requirements.

1.8.2.2. Excess Soil Work. Acceptable excess soil shall be delivered to the designated location(s) following approved haul routes. For the site where excess soil is deposited on government land, the Contractor may be required to perform final grade and seeding according to project requirements.

1.8.3. Sample Plan. At least one composite sample (6-8 grabs) for each undisturbed borrow source would be taken from the original point of excavation and required for each 5,000 CY of soil. For soil taken from disturbed borrow sources, samples are required for each 1,000 CY of soil. The nature of the borrow source is to be considered when determining the quantity and depth of the samples. Additional samples may be required to adequately characterize the proposed borrow source (i.e. laterally and vertically). The Contractor shall submit a Sample Plan (to include site map, excavation area, location and depth of samples) for 633 CES/CEA review and approval.

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1.8.4. Chemical Testing Standards. The analysis must be performed by a laboratory approved by the U.S. Asset Management Protection Agency. Submit a copy of the chain of custody and complete validated report of analysis to 633 CES/CEA for review and approval 30-days prior to use of any borrow soils. Chemical testing of any borrow source will include sampling for the following suite of contaminants (test requirements may be reduced based on borrow source information):

- Total Petroleum Hydrocarbons (TPH) to include Gasoline Range Organics (GRO) and Diesel Range Organics (DRO);
- Volatile Organic Compounds (VOCs) [EPA method 8260B] to include Benzene, Toluene, Ethylbenzene, and Xylene (BTEX);

The soil support test suite shall also include unless generator knowledge suggests otherwise:

- Semi-volatile Organic Compounds (SVOCs) [EPA method 8270];
- Pesticides [EPA method 8081A];
- Polychlorinated Biphenyls (PCBs) [EPA method 8082]; and
- Target Analyte List (TAL) metals (including Mercury) [EPA method 6010B/7470A]
- Volatile Organic Compounds (VOCs) [EPA Method 8260] other than BTEX compound reference in the preceding paragraph.

1.8.5. Clean Soil Determination. Soils testing under the EPA screening levels and/or base “background” levels will be considered acceptable “clean” soil. Generally, acceptable clean soil must not exceed EPA Region III “Residential” Risk Based Concentrations (RBC) and the LAFB Upper Tolerance Limit (UTL) background soil concentrations. For use in current and future industrial areas, EPA Region III “Industrial” RBCs may be considered but shall not exceed UTL background levels.

1.8.6. Excavation and Delivery Screening. Common to any multiple point sampling, composite testing may not accurately characterize the entire site. Should contamination be detected (e.g. free product, stained soils, chemical odors) during excavation or delivery, soil operations shall be immediately discontinued pending 633 CES/CEA notification and resolution. Additional soil testing and screening may be required to determine if continued use of the borrow site is acceptable.

1.8.7. Material Physical Characteristics. All soil obtained from sources within or outside the limits of government-controlled land shall meet the physical characteristics as defined in project specifications.

## 1.9 TREE PROTECTION, PRESERVATION, AND PLANTING

1.9.1. Tree Protection – trees take generations to mature, yet they can be irreparably damaged or killed within seconds, or subjected to conditions which may take five (5) to ten (10) years to kill them. Improper planting may result in short-term death, structural failure, or a long-term senescence. Most situations can be prevented.

1.9.2 Because trees contribute so much to our quality of life and because they can be a potential liability, they must be actively conserved, wisely selected, well placed, well planted, routinely

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

maintained, and constantly protected. One of the most critical steps in planning for trees and cost effective ways of managing trees is to maintain adequate growing space for each tree's roots, trunk, and crown throughout the tree's life. Remember that as a tree gets older it gets larger and the growing space it requires increases accordingly.

1.9.3. For existing trees, there is a minimum amount of area, above (for the trunk and crown) and below ground (for soil health and the root system) that is required to protect trees and preserve tree health. This area has been identified as the critical root zone (CRZ) or tree protection zone (TPZ) by various experts and is generally agreed to be equivalent to the soil area below ground and the space above ground defined by the tree's dripline, or the greatest extent of the branches. This is depicted in Figure 1

1.9.4. For small trees, newly planted trees, and trees with narrow crowns, the dripline defines an area that is too small for proper protection. So it is best to define both the critical root and tree protection zones as the circular area above and below ground with a radius equivalent to the greater of 6 feet or 1.5 feet for every inch in trunk diameter at 4.5 feet above the ground. For example, a tree with a trunk diameter (dbh) of 20 inches has a CRZ and TPZ of 30 feet (20 inches x 1.5) around the tree. While the radius of the CRZ (and TPZ) is 30 feet, the diameter of the entire CRZ (and TPZ) is 60 feet.

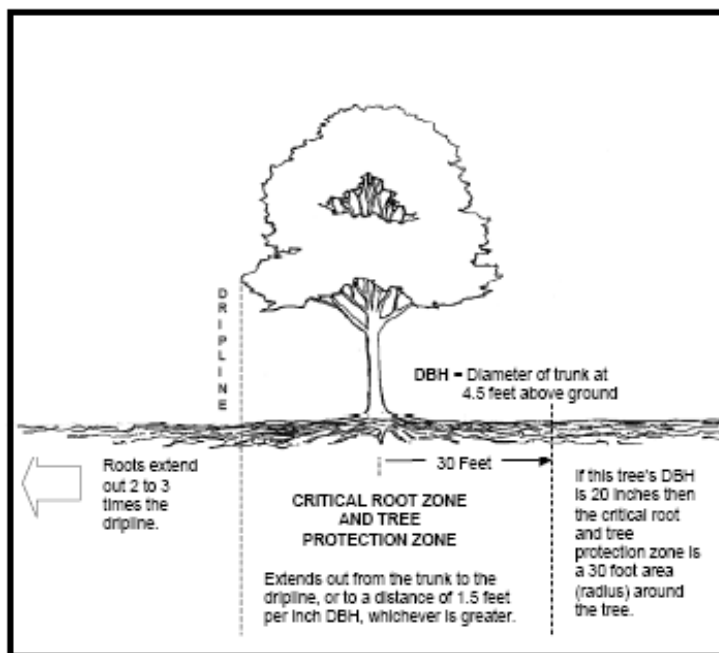


Figure 1. Location of the Critical Root Zone and Tree Protection Zone

## Guide to Working Around Trees - How Trees Are Damaged During Construction

### Physical injury to the trunk and crown

Construction equipment can injure the above-ground portion of a tree by breaking branches, tearing the bark, and wounding the trunk. These injuries are permanent, and if extensive, can be fatal.



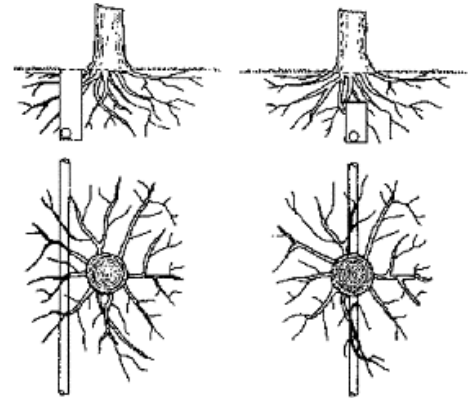
SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS**Physical injury to the trunk and crown**

- Soil compaction in the root zone
- Severing of roots
- Smothering roots by adding soil
- Split and broken branches
- New exposure to wind and sunlight

**Soil compaction**

An ideal soil for root growth and development is about 50% pore space. These pores, the spaces between soil particles, are filled with water and air. The heavy equipment used in construction compacts the soil and can dramatically reduce the amount of pore space. This not only inhibits root growth and penetration but also decreases oxygen in the soil that is essential to the growth and function of the roots.

**The roots of a tree will extend far from the trunk and will be found mostly in the upper 18 inches of the soil.**



**Less damage is done to tree roots if utilities are tunneled under a tree rather than across the roots.**

**Need Assistance ?**

**1<sup>st</sup> Civil Engineer  
Squadron**

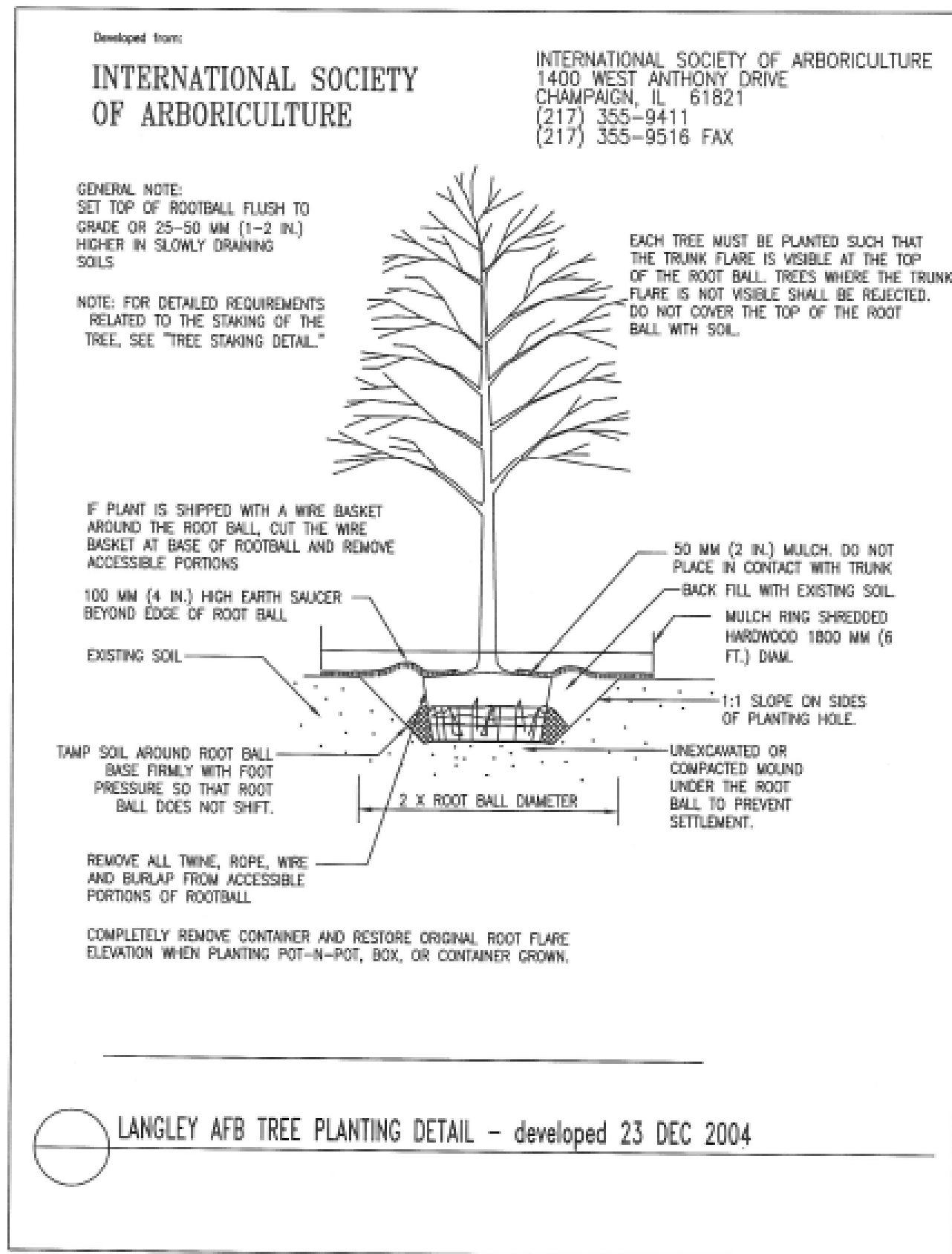


**H. Reed Jeavons**  
Asset Management Management Flight  
Natural Resources Planner  
ISA Certified Arborist #MA-0674A

1 CES/CEA DSN 574-1090  
37 Sweeney Blvd COMM/VOICE: (757) 764-1090  
Langley AFB, Virginia 23665-2107 FAX: (757) 764-8615  
e-mail: [harry.jeavons@langley.af.mil](mailto:harry.jeavons@langley.af.mil)

**Cutting of roots**

The digging and trenching that are necessary to construct a house and install underground utilities will likely sever a portion of the roots of many trees in the area. It is easy to appreciate the potential for damage if you understand where roots grow. The roots of a mature tree extend far from the trunk of the tree. In fact, roots typically will be found growing a distance of 1-3 times the height of the tree. The amount of damage a tree can suffer from root loss depends, in part, upon how close to the tree the cut is made. Severing one major root can cause the loss of 5-20% of the root system.

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

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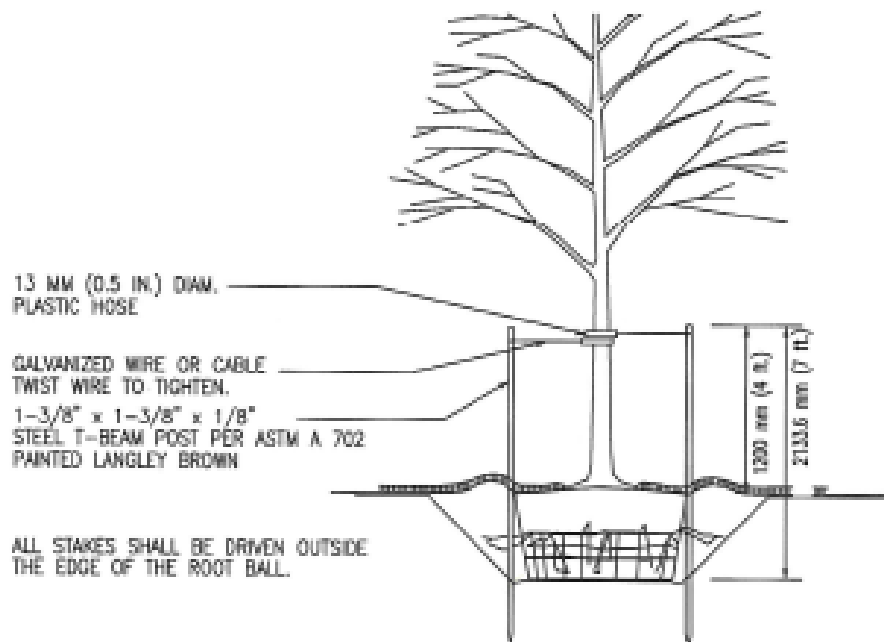
original available from [www.caddetails.com](http://www.caddetails.com)



SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONSDEVELOPED FROM:  
**INTERNATIONAL SOCIETY  
OF ARBORICULTURE**INTERNATIONAL SOCIETY OF ARBORICULTURE  
1400 WEST ANTHONY DRIVE  
CHAMPAIGN, IL 61821  
(217) 355-9411  
(217) 355-9516 FAXWIRE OR CABLE SIZES SHALL BE AS FOLLOWS:  
TREES UP TO 65 MM (2.5 IN.) CALIPER – 14 GAUGE  
TREES 65 MM (2.5 IN.) TO 75 MM (3 IN.) CALIPER – 12 GAUGE

TIGHTEN WIRE OR CABLE ONLY ENOUGH TO KEEP FROM SLIPPING. ALLOW FOR SOME TRUNK MOVEMENT. PLASTIC HOSE SHALL BE LONG ENOUGH TO ACCOMMODATE 35MM (1.5 IN.) OF GROWTH AND BUFFER ALL BRANCHES FROM THE WIRE.

TUCK ANY LOOSE ENDS OF THE WIRE OR CABLE INTO THE WIRE WRAP SO THAT NO SHARP WIRE ENDS ARE EXPOSED.

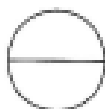


ASSURE THAT THE BEARING SURFACE OF THE PROTECTIVE COVERING OF THE WIRE OR CABLE AGAINST THE TREE TRUNK IS A MINIMUM OF 12 MM (0.5 IN.).

REMOVE ALL STAKING AS SOON AS THE TREE HAS GROWN SUFFICIENT ROOTS TO OVERCOME THE PROBLEM THAT REQUIRED THE TREE TO BE STAKED. STAKES SHALL BE REMOVED NO LATER THE END OF THE FIRST GROWING SEASON AFTER PLANTING.

## NOTES

1. PLEASE REFER TO INTRODUCTION AND USE CRITERIA PRIOR TO USING THIS DETAIL.



LANGLEY AFB TREE STAKING DETAIL

DEVELOPED 27 DEC 2004

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

## 1.9.5 Tree Protection Zone Structures

- Chain link fence – 48-inch minimum height
- Snow/Sand fence - 48-inch minimum height
- Safety fence - 48-inch minimum height

1.10 Discrepancies. In case of a conflict or discrepancy between Asset Management regulations or laws and the contract specifications, the Contractor shall immediately submit the matter in writing to the Contracting Officer for a determination. Without such determination any actions taken shall be at the Contractor's own risk and expense.

---

## 1.12 References:

1. EPA Region III Risk Based Concentration (RBC) table. As this table is updated every 6 months, analysis is to be determined by the table current at the time of testing. This table can be found at <http://www.epa.gov/reg3hwmd/risk/human>.
2. Background Chemical Data Document for Langley AFB, 21 Oct 97, Table 7-1. The UTL (Upper Tolerance Limit) Summary Table outlines the Langley AFB's background data set. This table can be requested through 633 CES/CEA.

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

## ATTACHMENT 1

## CONSTRUCTION/DEMOLITION DEBRIS RECYCLING AND REPORTING

As stewards of the environment and because of the Air Force goals of diverting greater than 40% of its waste away from landfills, Contractors shall recycle C&D debris to the maximum extent possible. There are many sources in the local area that can recycle C&D. A list of sources can be found in the "Special Conditions" portion of Langley construction contracts. If you need further assistance finding sources, contact the 633 CES/CEA Pollution Prevention Manager at 757-764-3987. Langley AFB must report recycling metrics to higher Headquarters quarterly. Therefore, complete the form below for each project on Langley AFB and submit a copy to the 1 CONS Contracting officer, the 633 CES/CEP Project Manager, and 633 CES/CEAN (Pollution Prevention Program Manager), by the 5<sup>th</sup> day of each quarter (5 Apr, 5 July, 5 Oct, and 5 Jan) for the previous three month period for the duration of the project.

PROJECT NUMBER AND TITLE: \_\_\_\_\_

PROJECT LOCATION (BLDG # AND STREET ADDRESS): \_\_\_\_\_

\_\_\_\_\_

CONTRACTOR NAME: \_\_\_\_\_

CONTRACTOR ADDRESS/PHONE NUMBER: \_\_\_\_\_

\_\_\_\_\_

## TYPE ITEMS RECYCLED:

\_\_\_\_\_ Concrete without rebar

\_\_\_\_\_ Concrete with rebar

\_\_\_\_\_ Scrap Metals

\_\_\_\_\_ Wood

\_\_\_\_\_ Roofing Materials

\_\_\_\_\_ Brick

\_\_\_\_\_ Asphalt

\_\_\_\_\_ Other: Specify \_\_\_\_\_

TONNAGE OF ITEMS RECYCLED: \_\_\_\_\_ TONS

## TYPE ITEMS NOT RECYCLED:

\_\_\_\_\_ Concrete without rebar

\_\_\_\_\_ Concrete with rebar

\_\_\_\_\_ Scrap Metals

\_\_\_\_\_ Wood

\_\_\_\_\_ Roofing Materials

\_\_\_\_\_ Brick

\_\_\_\_\_ Asphalt

\_\_\_\_\_ Other: Specify \_\_\_\_\_

CONTINUED ON THE BACK

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

C&D DEBRIS RECYCLING AND REPORTING FORM (CONT'D)

REASONS ITEMS WERE NOT RECYCLED:

\_\_\_\_\_ No market for the items

\_\_\_\_\_ No local vendors to recycle the materials

\_\_\_\_\_ Not economically feasible: Specify: \_\_\_\_\_

\_\_\_\_\_ Other: Specify: \_\_\_\_\_

PROVIDE NAME OF COMPANY, POINT-OF-CONTACT, AND PHONE NUMBER OF SOURCE BY WHICH RECYCLING AN ITEM(S) WERE ATTEMPTED:

Company Name: \_\_\_\_\_

Point of Contact: \_\_\_\_\_

Phone Number: \_\_\_\_\_

C&D ITEMS DISPOSED OF BY LANDFILL: \_\_\_\_\_ TONS

C&D ITEMS DISPOSED OF THROUGH REGULAR INCINERATION: \_\_\_\_\_ TONS

ITEMS DISPOSED OF BY WASTE-TO-ENERGY INCINERATION: \_\_\_\_\_ TONS

\_\_\_\_\_  
CONTRACTOR SIGNATURE

\_\_\_\_\_  
DATE

NOTE: ELECTRONIC SIGNATURE ACCEPTABLE

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

## ATTACHMENT 2

Contractor Hazardous Material Worksheet

FOR ASSISTANCE WITH THIS WORKSHEET CONTACT LAFB HAZMART AT 757-764-3837  
CORRESPONDING MATERIAL SAFETY DATA SHEET MUST BE ATTACHED.

CONTRACTOR INFORMATION

Prime Contractor name:  
Subcontractor name (if applicable):  
Project Manager POC name:  
Contracting Office POC:  
Contract #:  
Project #:  
Project title:  
Project date range:                    through                    (mm-dd-yyyy)

MATERIAL INFORMATION

Part number (from MSDS) or National Stock Number:  
Noun/Common Name:  
Type of Container (ex - can, bucket, box):  
Size (ex - 1 gal, 5 gal, 1qt, 500 mL, tank):  
Unit of Issue (ex - each, box/12, case/24):

DRAW INFORMATION

Estimated amount of this material to be used for duration of contract\*:

*\* At project completion, submittal summarizing actual usage is required*

TASK INFORMATION

Task Description (describe what it is used for):

LOCATION INFORMATION

Will the process be performed in: (check all applicable locations)

☐ A facility, ☐ aircraft, ☐ equipment, ☐ manhole, ☐ other structure? ☐ Outdoors?

Is material going to be used in an area occupied by USAF military or civilians? ☐ Yes ☐ No

What is the storage location of unused materials?

Will respirators be worn?                    Yes                    No

Will a ventilation system be used?                    Yes                    No

REMARKS (provide any additional comments or information)

Contractor Point of Contact

Requestor's Name:

Title:

Address:

Phone Number:

Date:

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

<p style="text-align: center;">To Be Completed by USAF Personnel Only</p> <p>EMIS Shop Code: _____</p> <p>BEE: ____ Recommend Approval ____ Recommend Disapproval: Comments:</p> <p>SE: ____ Recommend Approval ____ Recommend Disapproval Comments:</p> <p>CEA: ____ Approve ____ Disapprove Comments:</p> <p>HAZMART: ____ Concur ____ Nonconcur Comments:</p>
--

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

## ATTACHMENT 3

## CONTRACTOR'S MONTHLY REPORT FOR HAZMATS

Contractor:

Shop Code:

Contract#:

Location:

The following information is required for tracking of hazardous materials on Langley AFB. For contracts exceeding six months, this form is required to be filled out on a monthly basis and returned to the Government project Quality Assurance Personnel (QAP). For contracts that are less than six months, this form is required at the beginning and at the completion of the work. The QAP will provide a copy to the HAZMART Pharmacy located in Bldg 330. This information is required to comply with State, Federal, local, and Air Force laws and regulations.

MATERIAL NAME	MANUFACTURER	NSN/PART #	START BALANCE	AMOUNT USED

Use additional sheets if required.

Contractor Name: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_

Government QAP: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

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SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

## ATTACHMENT 4

## CONTRACT SUBMITTAL AND CONTRACTOR REPORTING FORM

## Comprehensive Procurement Guidelines

(This chart is not intended to replace the EPA guidelines found at <http://www.epa.gov/cpg/products.htm>). It is the Contractor's responsibility to stay apprised of any new additions to these guidelines. )

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
<u>VEHICULAR PRODUCTS</u>				
Engine coolants - antifreeze				
Rebuilt vehicular parts				
Re-refined lubricating oils - including motor oil				
Retread tires				
<u>CONSTRUCTION PRODUCTS</u>				
Building insulation products				
Carpet (Polyester)				
Carpet cushion				
Cement and concrete containing coal fly ash, ground granulated blast furnace slag, cenospheres, or silica fume				
Consolidated and reprocessed latex paint				
Floor tiles				
Flowable fill				

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
Laminated paperboard				
Modular threshold ramps				
Nonpressure pipe				
Patio blocks				
Railroad grade crossing surfaces				
Roofing materials				
Shower and restroom dividers and partitions				
Structural fiberboard				
<u>LANDSCAPING PRODUCTS</u>				
Compost made from yard trimmings or food waste				
Garden and soaker hoses				
Hydraulic mulch				
Lawn and garden edging				
Plastic lumber landscaping timbers and posts				
<u>NON-PAPER OFFICE PRODUCTS</u>				
Binders				

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
<u>NON-PAPER-OFFICE PRODUCTS</u> (cont)				
Clipboards				
Clip Portfolios				
File folders				
Presentation Folders				
Office Furniture				
Office recycling containers				
Office waste receptacles				
Plastic desktop accessories				
Plastic envelopes				
Plastic trash bags				
Printer ribbons				
Toner cartridges				
<u>PAPER AND PAPER PRODUCTS</u>				
Commercial/industrial sanitary tissue products				
Miscellaneous papers				

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
Newsprint				
Paperboard and packaging products				
Printing and writing papers				
<u>PARK and RECREATION PRODUCTS</u>				
Park benches and picnic tables				
Plastic fencing				
Playground equipment				
Playground surfaces				
Running tracks				
<u>TRANSPORTATION PRODUCTS</u>				
Channelizers				
Delineators				
Flexible delineators				
Parking stops				
Traffic barricades				
Traffic cones				

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

Categories and Designated Items (Note: This table includes proposed CPG items as well as items designated final.)	If marked w/ an "X", item is applicable	Purchased with no recycled content	Purchased with recycled content	Percent of recycled content
<u>MISCELLANEOUS PRODUCTS</u>				
Awards and plaques				
Bike Racks				
Blasting grit				
Industrial drums				
Manual-grade strapping				
Mats				
Pallets				
Signage				
Sorbents				

SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

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SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

## ATTACHMENT 5

RECOVERED MATERIALS DETERMINATION FORM

This form is to be completed by the procurement originator for all purchases requesting an exemption from the Affirmative Procurement Program for Recovered Materials being procured. For questions on whether the product is “EPA designated” or what the required recycled content is, refer to the product descriptions on EPA’s website at <http://www.epa.gov/cpg/products.htm> . This form is not required for construction item purchases less than \$2,000, or for other purchases less than \$2,500.

Procurement Request/Project No. \_\_\_\_\_

## EPA Designated Eight Product Category Items

Category 1 Paper and Paper Products

<input type="checkbox"/> Commercial/industrial sanitary tissue products	<input type="checkbox"/> Paperboard/packing products <input type="checkbox"/> Miscellaneous papers	<input type="checkbox"/> Printing and writing papers <input type="checkbox"/> Newsprint
--	---	--

Category 2 Non-Paper Office Products

<input type="checkbox"/> Binders (paper, plastic)	<input type="checkbox"/> Plastic trash bags	<input type="checkbox"/> Plastic presentation folders
<input type="checkbox"/> Plastic envelopes	<input type="checkbox"/> Office waste receptacles	<input type="checkbox"/> Plastic clip portfolios
<input type="checkbox"/> Office recycling containers	<input type="checkbox"/> Plastic file folders	<input type="checkbox"/> Solid plastic binders
<input type="checkbox"/> Office furniture	<input type="checkbox"/> Plastic desktop accessories	<input type="checkbox"/> Printer ribbons
	<input type="checkbox"/> Plastic clipboards	<input type="checkbox"/> Toner Cartridges

Category 3 Park and Recreation Products

<input type="checkbox"/> Park benches and picnic tables	<input type="checkbox"/> Running tracks	<input type="checkbox"/> Playground equipment
	<input type="checkbox"/> Playground surfaces	<input type="checkbox"/> Plastic fencing

Category 4 Transportation Products

<input type="checkbox"/> Traffic barricades	<input type="checkbox"/> Delineators	<input type="checkbox"/> Traffic Cones
<input type="checkbox"/> Parking Stops	<input type="checkbox"/> Flexible delineators	<input type="checkbox"/> Channelizers

Category 5 Vehicular Products

<input type="checkbox"/> Engine Coolants	<input type="checkbox"/> Retread tires	<input type="checkbox"/> Re-refined lubricating oils	<input type="checkbox"/> Rebuilt vehicular parts
--	--	--	--

Category 6 Landscaping Products

<input type="checkbox"/> Garden and soaker hoses	<input type="checkbox"/> Hydraulic mulch	<input type="checkbox"/> Landscaping timbers and posts (plastic lumber)
<input type="checkbox"/> Yard trimmings compost	<input type="checkbox"/> Lawn and garden edging	<input type="checkbox"/> Food waste compost

Category 7 Construction Products

<input type="checkbox"/> Consolidated and reprocessed latex paint	<input type="checkbox"/> Railroad grade crossing and surfaces	<input type="checkbox"/> Structural fiberboard
<input type="checkbox"/> Cement and concrete containing coal fly ash, ground granulated blast furnace slag, cenospheres, or silica fume	<input type="checkbox"/> Building insulation	<input type="checkbox"/> Carpet (polyester)
<input type="checkbox"/> Roofing materials	<input type="checkbox"/> Shower and restroom dividers	<input type="checkbox"/> Carpet cushion
	<input type="checkbox"/> Laminated paperboard	<input type="checkbox"/> Floor tiles
	<input type="checkbox"/> Modular threshold ramps	<input type="checkbox"/> Patio blocks
	<input type="checkbox"/> Nonpressure pipe	<input type="checkbox"/> Flowable fill

Category 8 Miscellaneous Products

<input type="checkbox"/> Manual-grade strapping	<input type="checkbox"/> Mats	<input type="checkbox"/> Pallets	<input type="checkbox"/> Industrial drums
<input type="checkbox"/> Bike racks	<input type="checkbox"/> Awards and plaques	<input type="checkbox"/> Sorbents	<input type="checkbox"/> Signage
<input type="checkbox"/> Blasting grit			



SECTION 01 12 00 – ASSET MANAGEMENT SPECIAL CONDITIONS

## EXEMPTION CERTIFICATION

\_\_\_ The following EPA designated guideline item is included in the specifications for the project however, compliance with EPA standards is not attainable.

Item: \_\_\_\_\_

I have determined that the EPA guidelines were considered and determined inapplicable, based on the following:

\_\_\_ Item is not available within a reasonable period of time.

(Need date: \_\_\_\_\_ Date available: \_\_\_\_\_)

\_\_\_ Item fails to meet a performance standard in the specifications.

Specifically, \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_ Item was only available at an unreasonable price (i.e., recycled item cost more than non-recycled item).

Price of recycled item: \_\_\_\_\_

Price of non-recycled item: \_\_\_\_\_

\_\_\_ Item is not available from 2 or more sources.

*Market research was performed by calling \_\_\_\_\_ (insert number)*

*vendors, but only \_\_\_\_\_ (enter name) was able to supply the item.*

This determination is made in accordance with FAR 23.405(c).

\_\_\_\_\_  
Procurement Originator/Contractor

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of GPC Approving Official (if GPC used)  
or Project Manager/Supervisor/Flight Chief or Deputy for all other type purchases

\_\_\_\_\_  
Date

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

Section: APPENDIX CC

(Not Supplied)

## APPENDIX CC

### Design Compatibility Guidelines Langley Air Force Base VA

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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# DESIGN COMPATIBILITY GUIDELINES

Langley Air Force Base  
Virginia



MARCH 2006



AIR COMBAT COMMAND  
UNITED STATES AIR FORCE

# DESIGN COMPATIBILITY GUIDELINES

Langley Air Force Base, Virginia



MARCH 2006

Prepared by:



Tuesday, July 13, 2010

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- 2.2 Project Review Requirements
- 2.3 Non-Compliant Designs
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- Appendix B: Langley AFB Land Management Plan
- Appendix C: Langley AFB Preferred Plant Species List
- Appendix D: Langley AFB Supplement to ACCI 32-1054
- Appendix E: Project Personnel

**SECTION 1.0****Executive Summary**

The primary purpose of the *Langley Design Compatibility Guidelines (DCG)* is to establish guidelines that will create a unified visual character for the entire installation. Design compatibility focuses on harmony of all of the components that shape the appearance of the base. This includes, but is not limited to, building form, color and type of materials, landscaping, site furnishings, site design, and signage.

ACC has developed general standards intended to provide consistency and harmony among ACC installations; a copy is provided in Appendix A. These ACC Standards have been further supplemented here to take advantage of the design opportunities at Langley AFB.

Given the geography and history of Langley Air Force Base, it is prudent to separate portions of the base into six distinct visual areas: Heavier Than Air (HTA), Lighter Than Air (LTA), Shellbank, Flight Line, North Base and Bethel Manor Housing (see Figure 1-1C). Each visual area is defined by current land use and by the proposed architectural theme and materials for the area (see Figure 1-2A).

The HTA, LTA, and Shellbank Areas (the most visible parts of the base) need to work together to provide a positive physical identity for Langley Air Force Base. The architectural theme of the HTA residential area is English Tudor Revival and of the LTA is Colonial Revival. The administrative and industrial buildings in these areas generally utilize the scale and materials of the residential structures creating a sense of unity. The organization of structures in these areas also gives a strong sense of scale and community. Future improvements in these districts should enhance this sense of community and strong architectural theme. A thorough report and discussion of the historic buildings and historic resources can be found in *Cultural Resources Management Plan (CRMP)* prepared for the base.

The Shellbank Area is the most contemporary area of the base, and is a collection of various modern styles. Each new facility constructed in this area helps define a sense of community, scale and continuity while being mindful of the adjacent historic LTA & HTA areas.

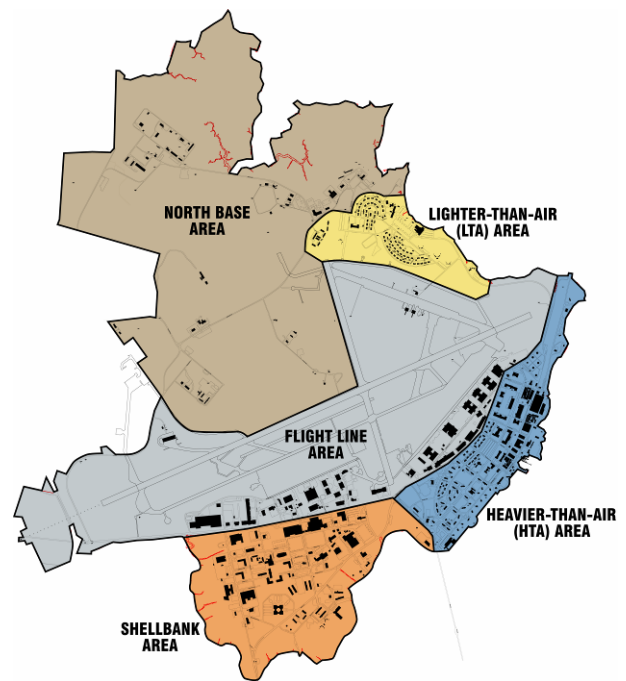
These guidelines are influenced by the historically significant structures and site planning that provide the framework for reinforcing and maintaining a positive visual image at Langley AFB.



1-1A Aerial view of Langley AFB



1-1B Langley AFB's Memorial Park



1-1C Visual Areas Map (Bethel Manor Housing not shown on map)

**Executive Summary SECTION 1.0****MATERIAL MATRIX – LANGLEY**

		VISUAL AREAS					
		HEAVIER-THAN-AIR (HTA)	LIGHTER-THAN-AIR (HTA)	SHELLBANK	FLIGHT LINE	NORTH BASE	BETHAL MANOR HOUSING <sup>3</sup>
MATERIALS							
WALLS	Stucco - (verify color with 1CES POC)	1	1				
	Brick – (color must be approved by Base Civil Engineer)	X	X	X	X	X	
	Metal Panel (Hangars only) - (verify color with 1CES POC)				X		
ROOF	Standing Seam Metal – Clay Tile Red, Gray, Dark Bronze (Non-housing only) (color selected on a project by project basis, must be approved by Base Civil Engineer)	X	X		X		
	Standing Seam Metal – Dark Bronze (Non-housing only) (color must be approved by Base Civil Engineer)			X		X	
	Heavy duty Fiberglass Reinforced Shingles – Clay Tile Red, Gray, Dark Bronze (color selected on a project by project basis, must be approved by Base Civil Engineer)	X	X				
	Heavy duty Fiberglass Reinforced Shingles – Dark Bronze (color must be approved by Base Civil Engineer)			X			
	Clay or Slate Tile – (color must be approved by Base Civil Engineer)	2	2				
DOOR/ WINDOWS	Aluminum windows and storefront – Dark bronze anodized or dark brown (Federal Standard 595B_20117) (Non-housing only)	X	X	X	X	X	
	Metal exterior doors – color to match adjacent wall or trim color, or for housing areas, beige/tan can be used	X	X	X	X	X	
	Aluminum or aluminum clad wood windows – Beige or Tan (Housing only)	X	X			X	
TRIM/ACCENT	Prefinish metal trim						
	Precast Concrete (color to match limestone)	X	X	X	X	X	
	Painted wood trim (Housing only)	X					

1. Only for repair or maintenance of historic work, or in conjunction with decorative brick work
2. Only for repair or maintenance of historic work
3. Projects in the Bethel manor area must comply with design standards established in the privatized housing contract (see the base POC to obtain them)

**1.2A Exterior Material Matrix**



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**SECTION 2.0**  
**Introduction**

## 2.1 Scope of the Document

The *Design Compatibility Guidelines* document establishes criteria for design of the site and built environment at Langley AFB.

It is intended for use by personnel involved in all phases of Base planning and design. Base personnel should refer to this manual when:

- Designing new projects
- Designing additions or renovations
- Providing maintenance and repair

Private sector firms contracted to provide professional architectural or engineering services should become familiar with the guidelines prior to the start of a project.

These design standards will establish continuity and baseline aesthetics for Langley AFB. These standards are not intended to be all encompassing or to limit design approaches, but to be a palette from which architects and designers may choose. ACC policy and this *Langley DCG* will work together to provide basic criteria for all buildings and improvements. The results will provide a sense of unity and aesthetic harmony to the base.

## 2.2 Project Review Requirements

- All projects, in-house work orders, and self-help work orders will include an architectural review by the Base Civil Engineer.
- Self-help projects must be coordinated with CE's Engineering Flight prior to design and after construction is completed.
- All other projects will include an architectural review at the 35% preliminary design submittal.

## Introduction SECTION 2.0

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### 2.3 Non-Compliant Designs

- Proposed designs that do not comply with the *Langley Design Compatibility Guidelines* require approval from the Base Civil Engineer.
- Proposed designs that do not comply with the *ACC Architectural and Interior Design Standards* require a waiver from the ACC Command Architect (ACC/A7DD). If waiver is not granted, projects must be redesigned to comply. Requests for waivers should be submitted early in the design process, but no later than the 35% Preliminary Design Submittal or prior to the start of self-help projects.



2-2A An F-15 and a C-21 fly over Langley AFB, VA

### 2.4 Base Mission

Langley AFB is the USAF's oldest continuously active air base. Its rich history and its important mission make it one of the nation's preeminent military installations. Langley AFB is home to the Headquarters Air Combat Command (HQ ACC) and the 1st Fighter Wing, which is the Base's host unit.

#### Langley Air Force Base Mission Statement:

- Remain a fully functioning Air Force Base capable of providing air operational support to a broad spectrum of American aircraft in both peacetime and combat environments.
- Sustain the resources and relationships deemed appropriate to pursue National interests shared by community and governmental agencies.
- Provide for the Command/Control/Communications (C3) necessary to execute the United States Air Force (USAF), Air Combat Command (ACC), and First Fighter Wing (1st FW) Vision and Missions.

#### Air Force Mission Statement:

- To defend the United States through control and exploitation of air and space.

**SECTION 2.0 Introduction****ACC Mission Statement:**

- Air Combat Command Professionals providing the World's Best Combat Air Forces Delivering Rapid, Decisive Air Power Any Time, Any Where.

**ACC Goals:**

- Improve our combat capability by meeting ACC quality performance measures in operations, maintenance, logistics, and training programs.
- Embrace a culture of ACC quality in everything we do, thus creating a leadership style and working climate that inspire trust, team work, and continuous improvement.
- Build air combat command and instill in it the heritage of the past and the vision of the future by delivering a global power for America.
- Improve safety performance by fostering a culture of safety in the air and on the ground.
- Create a spirit of wellness and fitness in all our people through quality physical, mental and spiritual programs.



2-3A F/A-22 Raptors over Langley AFB

**1st Fighter Wing Goals and Objectives:**

- Train and equip units to achieve the highest level of combat readiness.
- Improve efficiency and productivity in using our resources.
- Enhance the quality of life, both on and off duty, for all Wing members and their families.
- Emphasize an aggressive commitment to safety in all activities.
- Make environmental awareness and protection a daily practice.

**1st Fighter Wing Mission Statement:**

- America's First Team Setting the Standard in Air Supremacy.

## Introduction SECTION 2.0

### 2.5 Regional Setting

#### Geography

Langley AFB is located near the south end of the lower Virginia Peninsula on the Back River, an estuary of Chesapeake Bay. Langley is situated in the Hampton Roads Standard Metropolitan Statistical Area (SMSA), just outside of Hampton, Virginia. Other cities in the area include Newport News, Virginia Beach, Norfolk, Portsmouth, Suffolk, Williamsburg and Yorktown. Langley AFB is approximately 120 miles south of Washington, D.C. SMSA is home to many other military installations including Fort Eustis, Fort Monroe, Naval Base Norfolk, Oceana Air Station, and United States Atlantic Command.

#### Topography

Langley AFB falls within the Outer Atlantic Coastal Plain physiographic region of southeastern Virginia. The topography at Langley AFB is essentially flat with little or no relief. The elevation is from five to 11 feet above mean sea level base-wide. The Back River and its Northwest and Southwest Branches surround, on three sides, the low flat plain upon which Langley AFB is located. Plum Tree Island is to the east of the base and Hampton Roads is south.

#### Soils

According to cultural and archeological surveys, sediments here are mostly unconsolidated fluvial, marine, and estuarine deposits that may date as far back as the Cretaceous era, circa 135 million years ago. During the construction of the Base, fill was added for leveling. The fill was compacted in areas where buildings were constructed or beneath concrete areas. Land moving and filling activities at Langley AFB have altered soil profiles to the extent that site inspection of local soils does not concur with local soil surveys from adjacent counties.



2-4A Regional Location

**SECTION 2.0 Introduction****Climate**

The climatic conditions at Langley AFB are characterized by mild winters and warm, humid summers. This type of climate is generally described as "modified continental." The Appalachian Mountains to the west and the Atlantic Ocean and Chesapeake Bay to the east are major factors contributing to Langley's moderate climate. The mountains produce various modifying effects on passing storms while the ocean maintains the humidity during the summer and contributes to the mild winters.

South to southwest winds are predominate, but a secondary maximum from a northerly direction reflects the progression of weather systems across the state. Cloudiness is least during the fall season, averaging about 5/10s coverage, and greatest in winter, with 6/10s coverage. Langley, due to its close location to the Chesapeake Bay, is prone to hurricane, tropical storms, and northeasters, commonly referred to as "Nor'easters". To date, when a storm arrives in this area, it has decreased in strength to less than hurricane intensity, but still causes considerable damage from high winds and heavy rains. The last hurricane to cause damage at Langley was Hurricane Isabel in September 2003. Tornadoes are quite rare, but one struck the base during 1993 and caused limited damage. Thunderstorms, accompanied by lightning, hail and high winds are much more frequent and produce the greatest amount of storm damage in the area.

- Annual average temperature 60°F
- January monthly temperature 40°F
- July monthly temperature 79°F
- Annual average rainfall 44.15"
- Annual average snowfall 9.8"



2-5A Langley AFB Shoreline during Hurricane Isabel



2-5B Flooding from Hurricane Isabel (photo of HTA housing area)



## Introduction SECTION 2.0

### 2.6 History

Langley AFB is the oldest continuously active air installation in the United States Air Force. Established as an experimental air station in 1916, Langley's rich history parallels the history of manned flight in this country. In 1915, the National Advisory Committee for Aeronautics (NACA) was established for the purpose of continuing aeronautical research and experimentation. The decision was made in early 1916 to develop a joint research facility for NACA, the Aviation Section of the Army Signal Corps and the Navy. Most of the land that was to become Langley AFB was purchased by the government in 1916 for an Aeronautical Experimental Station and Proving Grounds. Consisting of six plantations, the land purchased for the experimental station was named Langley Field, in honor of Samuel Pierpont Langley, a pioneer in American aviation. Construction began in 1917. Operations began that same year.

The United States' entry into World War I resulted in changing Langley Field's original mission from a large experimental station to a fully operational flying field, with NACA as a tenant.

Early activities at Langley included the testing of foreign aircraft, bombardment and tactical training, and aerial photography training. Langley's association with lighter-than-air aviation began in 1918 with the arrival of a balloon detachment, and was followed by construction of an airship station in 1919. Several small non-rigid airships were acquired, as well as larger rigid and semi-rigid airships. Langley's association with lighter-than-air vehicles ended in 1935 with the departure of the only remaining airship.

Greater recognition of the Air Corps' basic mission led to reorganization in the 1930s. This resulted in the establishment of the General Headquarters Air Force, with headquarters at Langley Field. While this was not the separate Air Force sought by airmen, it was the first step toward the creation of an autonomous air arm within the Army. Langley rapidly became the U.S. Army's center of tactical aviation.



2-6A Langley AFB in 1930



2-6B Langley AFB in 1939

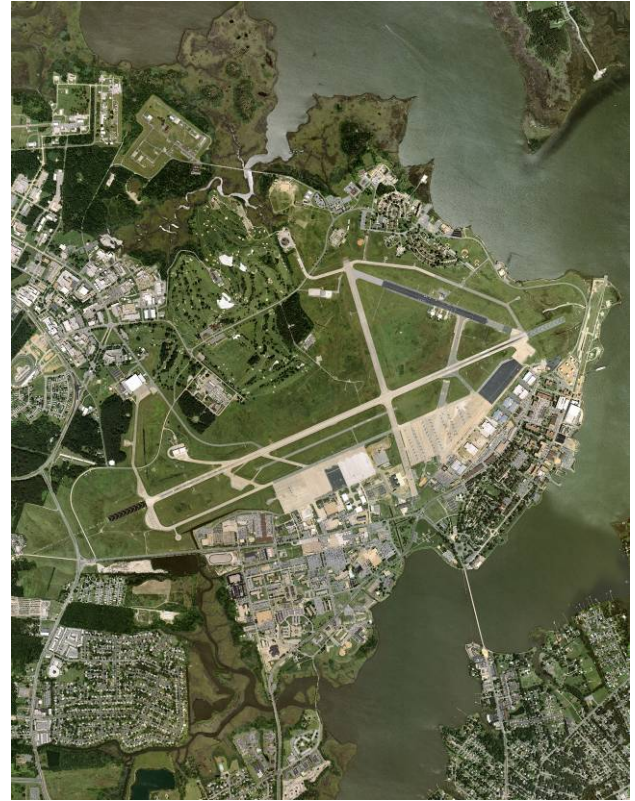
**SECTION 2.0 Introduction**

Entry into World War II led to the rapid expansion of personnel and aircraft stationed at Langley Field. The Shellbank Plantation, consisting of 770 acres, was purchased in 1941 to alleviate crowded conditions at Langley. Langley became headquarters of the 1st Bomber Command.

The Tactical Air Command of the Army Air Force established headquarters at Langley in 1946. In 1948, Langley Field was redesignated Langley AFB, after creation of the Department of the Air Force in 1947.

In 1958 NACA became the National Aeronautics and Space Administration (NASA) and the first seven astronauts trained in part at Langley. Langley continues its role in research and development to the present.

Langley AFB continues to be a leader in U.S. air power as the home of the 1st Fighter Wing and its designation as the Headquarters Air Combat Command in June, 1992. This was the result of the merger of the Strategic Air Command and the Tactical Air Command.



2-7A Langley AFB Today

## **Introduction SECTION 2.0**

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**SECTION 3.0****Architectural Character**

The design guidelines in this document have been formulated in response to three principal goals:

- Design facilities that are compatible with Langley's architectural heritage
- Maintain the campus atmosphere on base
- Ensure buildings project a corporate image for the Air Force

### 3.1 Design facilities that are compatible with Langley's architectural heritage

Langley AFB is rich in architectural history. The office of Cultural Resources in the National Park Service Southeast Regional office conducted a survey of the base architectural and historical resources in 1989. Three distinct areas were identified in this survey. These areas are the Heavier-than-Air (HTA) Area, Lighter-than-Air (LTA) Area and the Shellbank Area. The HTA and LTA areas date back to the beginning of the base, with major construction occurring in the 1930s. The Shellbank area is located on the old Shellbank Plantation acquired in 1941. Much development in this area had been completed by 1945.

Many of the structures in the HTA and LTA areas are eligible for listing on the National Register of Historic Places. Noted industrial architect Albert Kahn and his English associate, Ernest Wilby, designed and developed much of the original base. Albert Kahn was the appointed Architect-in-Chief of the Army Signal Corps. Most of the original structures and street patterns remain intact in the HTA area. The residential structures and street patterns in the LTA area are also largely intact but many other original structures have since been demolished. The rapid construction of the 1930s is due to a number of programs including the 1926 Air Corps Act's five-year expansion program, the Army Housing Program of 1926, the Emergency Relief and Construction Act of 1932, and the National Industrial Recovery Act's Public Works Administration of 1933. The predominant architectural style of the HTA area may be characterized as English Tudor Revival.



3-1A Example of Tudor Revival Style residence



3-1B Many of the original structures remain intact within the HTA area.

**Architectural Character SECTION 3.0**

The Tudor Style dates back to the 13th Century in England under the reign of Henry VII - the first of the Tudors. Tudor domestic architecture represents one of the earlier vernacular styles of house building in England. Domestic building came into prominence during this period due to the decline of feudalism and church supremacy. English Tudor architecture can be divided into three groups of materials - brick, stone, and half-timber, this being a function of geological condition and constraints of transportation at the time. Both the brick and half-timber styles may be found at Langley Air Force Base. Gothic and ecclesiastical motifs are common in Tudor architecture. Characteristic brickwork is displayed in wall designs where different colored bricks are used to form patterns known as "diapers" and in elaborately moulded and twisted chimney stacks. The Tudor arch is prevalent and characterized by cusping at the crown. Windows are important features of Tudor architecture. Cusped heads are common and tracery (or ornamental interlaced mullion compositions) are also prevalent.

Transoms, bay, and oriel windows became popular. Steeped pitched roofs, gables, and detailed chimney stacks lend a picturesque skyline. Symmetry is not a governing factor in English Tudor architecture.

Half-timber houses were apparent in heavily forested areas where an abundant supply of oak was available. These houses were constructed with a framework of heavy timbers that were then left visible with their curved struts and braces. The space between the timbers was filled in with lath and plaster or brickwork. Projecting upper floors can often be seen resting on exposed floor joists. Ornamental carving is often seen on the exposed timbers. Many of these above features are prevalent in the historical structures at Langley AFB.



3-2A English Tudor Revival Residence showing the heavy timber framework filled in with lath and plaster.



**SECTION 3.0 Architectural Character****3.2 Maintain the Campus Atmosphere**

Focus on the pedestrian is the key to the creation of a campus environment. These design guidelines propose methods for mitigating the negative impact of the automobile by separating parking from building entrances and linking buildings with shaded pedestrian paths. Additional shaded paths would increase pedestrian activity and help to overcome the perception that "it's too far to walk."

Campus buildings have clearly defined entrances and often include porticos and colonnades that act as a transition from building to site. These features are encouraged. The recommended building materials and fenestration patterns are designed to provide human scale on all buildings.

Landscaping with low maintenance, indigenous plant materials is an effective method of providing shaded pedestrian paths. Landscape guidelines requiring the use of a limited number of species will help unify the entire base.

**3.3 Ensure buildings project a corporate image for the Air Force**

"Corporate image" can be interpreted in a variety of ways. These design guidelines have been formulated to express an architectural character that projects an image of quality and permanence.

Common building forms and materials allow individual buildings to function as part of a larger whole. The unifying appearance of background buildings allows high profile buildings, such as headquarters or the chapel, to be focal points. This combination of background buildings and high profile object buildings work together to form the urban fabric.

Logical vehicular circulation and an emphasis on creating highly visible building entrances will further develop a unified, corporate image for base facilities.

"Corporate image" includes worker satisfaction as a priority. The design guidelines contain provisions for operable windows in all offices and living areas. The addition of site lighting, site furnishings and shaded outdoor lunch areas will also benefit building occupants.



3-3A Pleasant walkways encourage pedestrian activity.



3-3B Unifying background buildings allow building such as the chapel to be focal points.

## **Architectural Character SECTION 3.0**

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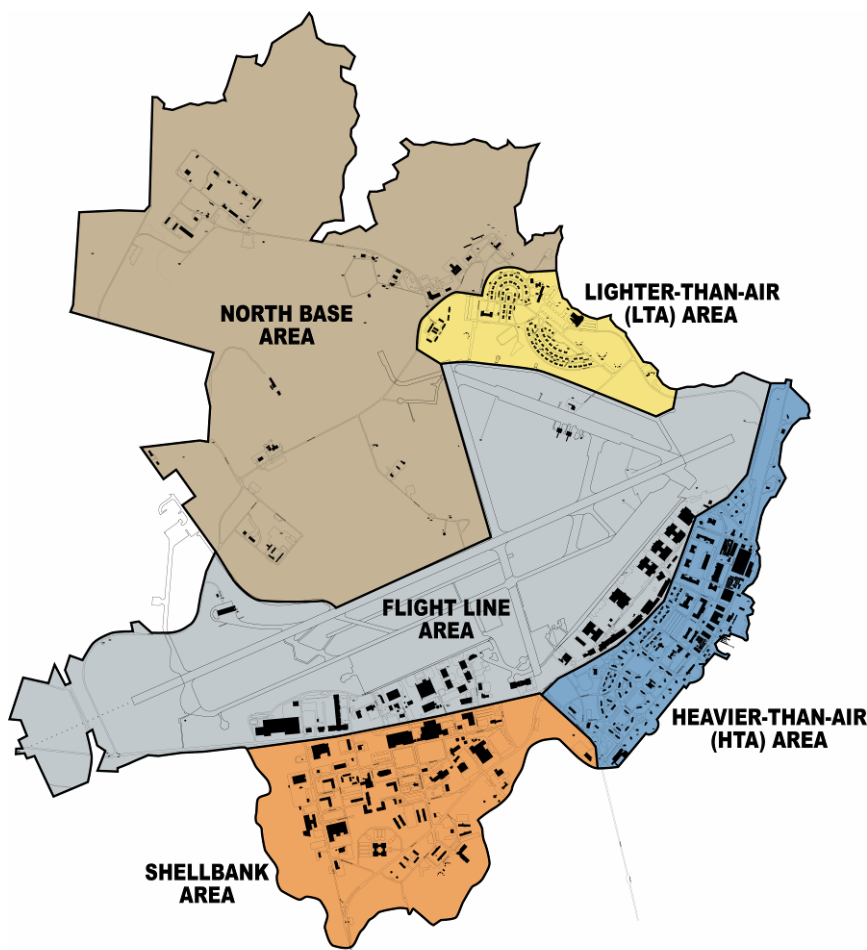
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**SECTION 4.0**  
**Visual Areas**

The *Langley AFB Design Compatibility Guidelines* organizes the physical environment of the base into six visual areas:

- Heavier Than Air (HTA)
- Lighter Than Air (LTA)
- Shellbank
- Flight Line
- North Base
- Bethel Manor Housing (located 6 miles from Base)

A fundamental purpose of this document is to provide a unified architectural character for the entire installation. Design recommendations for each area are coordinated to allow site and facilities to harmonize with the immediate surroundings, as well as support the overall design goals for the base.



4-1A Visual Area Map (Bethel Manor Housing not shown on map)



**Visual Areas SECTION 4.0****4.1 Heavier Than Air (HTA)**

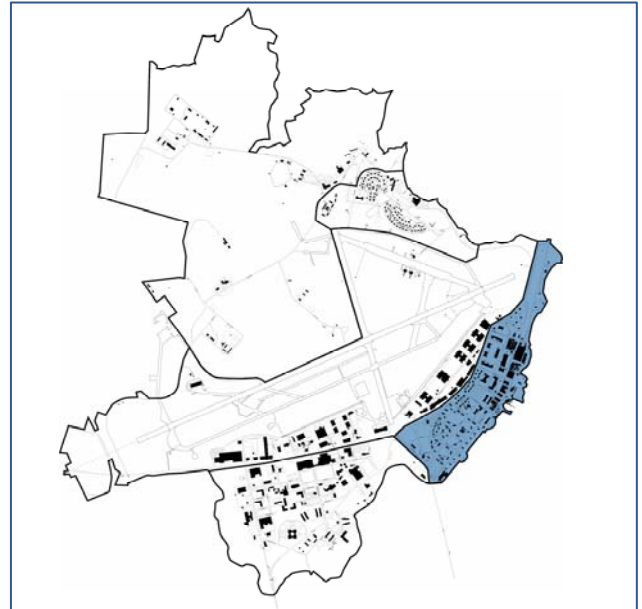
The HTA District is composed primarily of officers housing, administrative areas, and community related buildings, many of which are eligible for the National Register of Historic Places. It is approximately 208 acres, has an elongated shape with its major axis aligned NE-SW. The eastern boundary is the Back River and the western boundary is the flight line.

The residential area consists of single family and multiple family housing units. The English Tudor Revival style is prevalent. These structures are organized in a pleasant community setting with tree-lined streets.

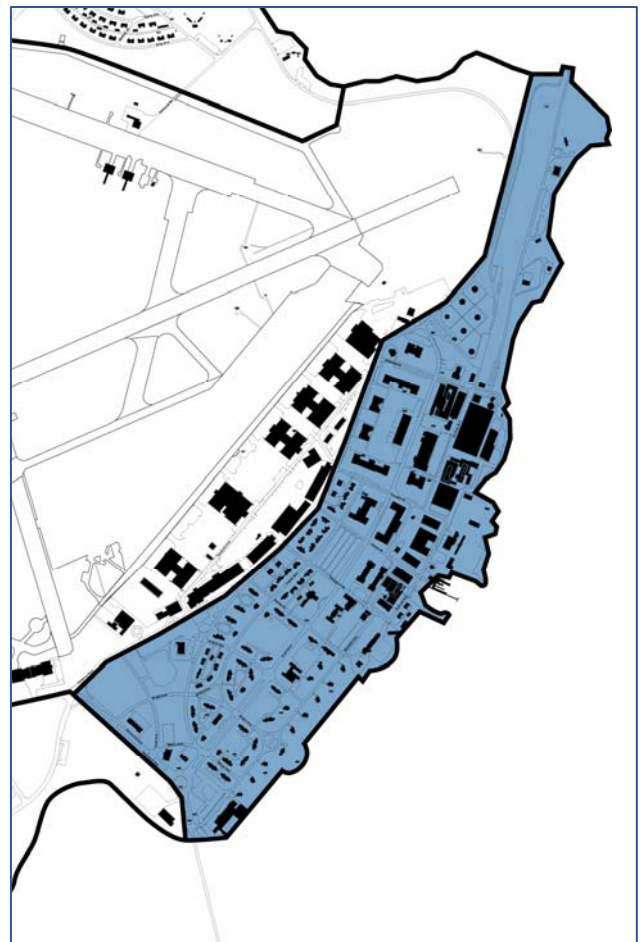
The administrative areas are organized in groups creating a good sense of community. These structures are composed primarily of red or brown flashed brick with patterns and detailing giving a unique sense of character to the area. Sweeney Boulevard separates the aircraft maintenance structures from the administrative and residential areas. Although larger in scale, these structures generally tie-in well to the HTA District. They are composed of masonry, have sloped roofs, and also have masonry detailing.



4-2A ACC Headquarters is located in the center of the HTA Visual Area.



4-2B Key Map



4-2C Heavier Than Air (HTA) Visual Area

**SECTION 4.0 Visual Areas**

This group of administrative, residential and aircraft maintenance buildings in the HTA Visual Area is an excellent example of how diverse uses can be harmonious. The industrial structures to the northeast bordered by Dodd Boulevard and Douglas Street are a departure from the districts style with a change of materials and scale. Even though the industrial nature of these buildings is strong and expressive relating directly to their use; they reference the overall character of the HTA Visual Area character with the use of color, masonry, and details.

**Site Planning**

- Focus on pedestrian circulation.
- If AT/FP setbacks guidelines can be met, new buildings must address streets using the same setbacks as adjacent historic structures.
- Parking should be located to the side or behind buildings.
- Parking should not be located between the building and principal street, unless properly landscaped and with the approval of ACC.

**Building Form**

- Maximum height for all buildings, except dormitories, is two stories. Dormitories may be three stories.
- Simple massing is recommended (Non-Housing).
- Building entrances should be easily visible from the street and parking areas.
- Locate the main entrance of the building on the principal street.
- Porticos, arcades and colonnades can be used to transition from the building to the site, and recall traditional character without directly repeating features found on historical buildings.
- Locate maintenance and trash services in less visible areas, to the rear or side of the building.
- Clustering of buildings to create courtyards and similar outdoor spaces is encouraged (Non-Housing).



4-3A *Well placed sidewalks.*



4-3B *Simple massing.*



4-3C *Entry portico with a traditional character.*



**Visual Areas SECTION 4.0****Roofs**

- Where roofing material requires repair or replacement on historic structures, materials, methods and procedures should follow those outlined in the *Cultural Resources Management Plan* (CRMP). Other circumstances should follow ACC policy, which strongly recommends sloped roof systems.
- The architecture of the HTA District is generally receptive of sloped roof design.
- Suitable sloped roof materials are heavy duty fiberglass reinforced shingles and standing seam metal roofing.
- Color must be selected on a project-by-project basis with a palette of gray, clay tile red, or dark bronze (verify colors with ICES POC). Selection must carefully examine the contextual environment.
- Roof edge treatment; whether an overhang, parapet or gable, adds significantly to building character. Overhangs should articulate the structure. Parapets should have emphasis with sculpted coping and cornice work.
- As a general rule, the contemporary form of using turned down standing seam metal roofing as a fascia is incompatible and shall not be used in the HTA District.
- Gutters, leader boxes, and downspouts will be copper on residential structures and aluminum (dark bronze) on industrial and administrative structures. At any existing facility, replace copper with copper.
- Except for historic repair work, clay tiles, slate, or artificial slate are not recommended; see the CRMP for restoration outlines.



4-4A Sloped roofs.



4-4B Sloped roofs with detailed overhangs.



4-4C Detailed roof soffit.



**SECTION 4.0 Visual Areas****Exterior Walls**

- Walls in the HTA District shall use brick as the primary material.
- Column bays, wall mass, buttresses, and corbelling are evident in existing building designs. New building designs will also be expressive of the nature of brick.
- Articulation of the walls shall utilize architectural pre-cast concrete to simulate limestone. The pre-cast units shall be elements such as water tables, plinth blocks, band coursing, lentils, keystones, cornice, coping, sills and etc.
- Brick creates patterns when used as water tables, arches, jack-arch lentils, and sills.
- Brick patterns that are strictly decorative may embellish walls when used as a border or in-fill panel. Stucco can be appropriate as a background. Numerous examples of decorative brick patterns can be found available in the HTA area.
- A word of caution is offered when a contemporary interpretation of the decorative brick patterns is considered. While being mindful of the character of the new work, do not allow new work to dilute the gusto expressed in the historic brickwork.
- Stucco, as an exterior material, should rarely be used except for repair and replacement of historic work; see the *Cultural Resource Management Plan (CRMP)*. Stucco is appropriate on small panels and areas in conjunction with decorative brickwork.

**Entries**

- A common attribute of the entrances in this area is a statement of presence. Designers should continue the character of the HTA Area's strongly stated entryways in both new and renovated work.
- The entryways may have a porch, a projection, a canopy, and may be detailed with brick pattern work, stone surrounds, and/or medallions.

4-5A *Brick detail with stucco background.*4-5B *Brick detail and English bond brick pattern.*4-5C *Articulated entrance emphasizes the sense of arrival.*

**Visual Areas SECTION 4.0****Windows**

- Administration facilities should have insulated windows with bronze tinted, non-reflective glazing. Glazing must meet AT/FP requirements.
- Housing facilities should have insulated windows with 10-15% tinted glazing and anodized aluminum frames with a beige or tan finish color.
- It is apparent that over the years nearly all of the original windows in the HTA District have been removed and replaced. The *Cultural Resource Management Plan* (CRMP) suggests in the historic buildings that windows with the appearance of the originals be installed where possible.
- New construction and additions should maintain the character and appearance of the original divided light windows.
- The windows in the facades of the HTA area buildings serve as portals for light and ventilation.
- HTA area windows are penetrations in the walls, as single windows or as panes. Windows should not be treated as in the modern sense, as curtain wall or ribbon windows.



4-6A Dark bronze anodized aluminum windows.



4-6B Beige anodized aluminum windows on housing.



**SECTION 4.0 Visual Areas****Site Furnishings**

- Trash dumpsters and service area screen walls should be the same material as adjacent structures.
- The style of the site furnishings should be consistent and reflect the historic character of this visual area.
- All site furnishing selections need to be approved by Base Civil Engineer and ACC. Figures 4-7A and 4-7B are examples of site furnishings that are appropriate for this area.

**Landscaping**

- This area has a modified grid development pattern. This provides opportunities to have straight tree-lined views along circulation corridors.
- This is one of the prominent visual areas, with several high profile facilities; the landscape, especially around the high profile buildings and King Street Entrance, should be more manicured and lush than other areas within the area.
- Courtyards and pedestrian areas should have shade trees and planting beds.
- Reserve using annual planting beds for high profile areas such as the ACC HQ building.



4-7A *Appropriate traditional style bench for the HTA Visual Area.*



4-7B *These light fixtures are appropriately used throughout the HTA Visual Area.*

**Visual Areas SECTION 4.0****4.2 LTA Area**

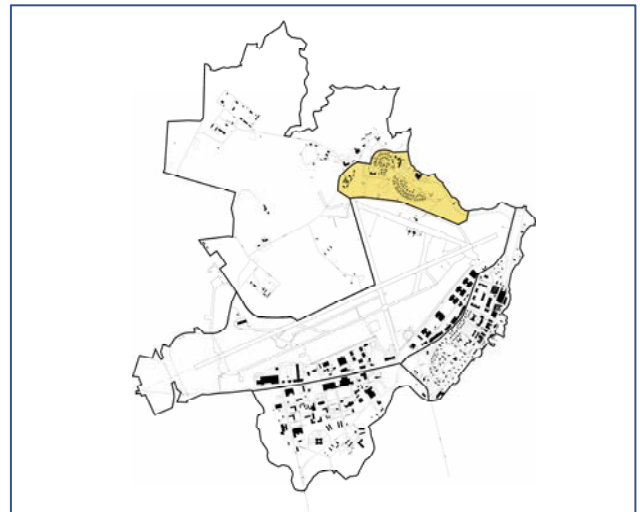
The LTA District is primarily composed of enlisted housing quarters with some community and administrative buildings to the north and south. Outdoor recreation areas are interspersed throughout the area. This district is approximately 142 acres, has an elongated shape with its major axis aligned W-E. It is located in the N-E portion of the base between the Northwest Branch Back River, Tabb Creek and the north aircraft-parking apron. Plan view of the street pattern is quiet unique. The semi-radial pattern is historic to the period and is reflected in historical and new developments in the Tidewater Area.

The residential structures are organized into a pleasant community setting. The buildings are in a Colonial Revival style. The neighborhood area developed in the 1930s and is organized around curvilinear streets, with a chapel as its focal point.

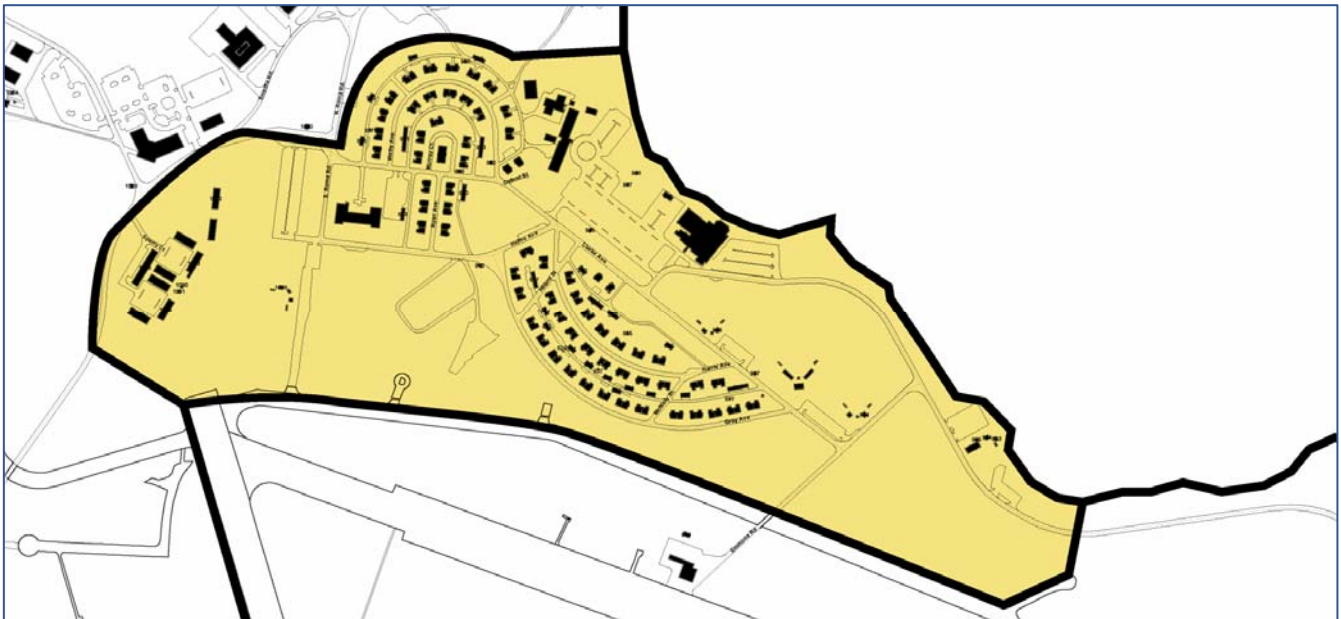
Screened porches, sloped roofs, brick and stucco walls, and exposed painted timber are elements that characterize these structures. The community and administrative buildings relate in a way to the residential areas by sharing sloped roofs and brick masonry walls. An industrial area is situated to the north of this area, but it is well separated by open space. The addition of landscape plantings would serve as an appropriate buffer.



4-8A Colonial Revival housing in the LTA Visual Area



4-8B Key Map



4-8C Lighter Than Air (LTA) Visual Area



**SECTION 4.0 Visual Areas****Site Planning**

- Focus on pedestrian circulation.
- If AT/FP setbacks guidelines can be met, new buildings must address streets using the same setbacks as adjacent historic structures.
- Parking should be located to the side or behind buildings.
- Parking should not be located between the building and principal street, unless properly landscaped and with the approval of Base Civil Engineer.

**Building Form**

- Maximum height for all buildings, except dormitories, is two stories. Dormitories may be three stories.
- Simple massing is recommended (Non-Housing).
- Building entrances should be easily visible from the street and parking areas.
- Locate the main entrance of the building on the principal street.
- Porticos, arcades and colonnades can be used to transition from the building to the site, and recall traditional character without directly repeating features found on historical buildings.
- Locate maintenance and trash services in less visible areas, to the rear or side of the building.
- Clustering of buildings to create courtyards and similar outdoor spaces is encouraged (Non-Housing).



4-9A Good pedestrian circulation in housing area.



4-9B Buildings exhibit simple massing of rectilinear forms.

**Visual Areas SECTION 4.0****Roofs**

- All new roofs shall be sloped.
- For non-residential structures, roofing material shall be standing seam metal (color: dark bronze to match roof color of other standing seam metal roofs in the vicinity) or architectural fiberglass shingles. Shingle color shall be approved by ICES on a case-by-case basis. Coordination with adjacent buildings may require shingles of slate gray, slate green, or tile red.
- Garages will have shingle roofs.
- Roof form and material shall coordinate with the general character of the LTA District buildings.
- Existing tile and slate roofing shall be maintained and restored as described in the base CRMP.
- Overhangs and fascia profiles are to be approximately one foot.
- Emphasis of the rake and eave is simple and not dramatic.
- Where necessary for roof runoff control, provide gutters and downspouts of copper or prefinished aluminum (color: dark bronze or Langley Brown). Maintain the predominant trim color scheme of adjacent structures.
- Gable and hip roof forms are preferred.
- Gable vents or windows and roof dormer vents or windows are acceptable as elements for interesting roof design.
- When applicable in the roof (and wall) design, the chimney may be used as a character-defining element.



4-10A Standing seam metal roofs are preferred for all non-residential buildings.



4-10B Roof forms are either Gabled or Hipped. Shingles are to be used on garages, and residential dwelling to be either clay tiles or shingles.



4-10C Chimneys are an important feature of the residential architecture.



**SECTION 4.0 Visual Areas****Exterior Walls**

- Brick is the primary material for the LTA District.
- The detailing of brick elements and bonds is simple. Provide modest detailing on chimneys, quoins, and building entrances.
- Provide a base for the buildings. This establishes a visual foundation and can be in the form of a water table.
- The older buildings utilize a concrete base in many cases. Except for additions made to these buildings, the expression of a water table or base should be done in brick.



4-11A Brick is the dominate wall material in the LTA Visual Area.

**Windows**

- Administration facilities should have insulated windows with bronze tinted, non-reflective glazing. Frames should be anodized aluminum with a dark-bronze finish. Glazing should be laminated to meet AT/FP requirements.
- Housing facilities should have insulated windows with 10-15% tinted glazing and anodized aluminum frames with a beige or tan finish color.
- It is apparent that over the years nearly all of the original windows in the LTA Area have been removed and replaced. The *Cultural Resource Management Plan (CRMP)* suggests in the historic buildings that windows with the appearance of the originals be installed where possible.
- New construction and additions should maintain the character and appearance of the original divided light windows.
- An important element of the windows in LTA Area facades is that they are portals for light and ventilation. LTA Area windows are penetrations in the walls, as single windows or as panes. Windows should not be treated as in the modern sense, as curtain wall or ribbon windows.



4-11B Installation of new windows in the residential housing feature frames with dark bronze finish.



4-11C Additions should maintain the architectural integrity of the original structure.

**Visual Areas SECTION 4.0**

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**Site Furnishings**

- Trash dumpsters and service area screen walls should be the same material as adjacent structures.
- The style of the site furnishings should be consistent and reflect the historic character of this visual area.
- All site furnishing selections need to be approved by Base Civil Engineer. Figures 4-12A, 4-12B and 4-12C are examples of site furnishings that are appropriate for this area.

**Landscaping**

- This area is primarily housing. The landscaping in this area should be a nice pedestrian scale; medium sized street trees, shrub planting areas in key areas, and the opportunity for residents to maintain their own annual planting beds.
- Use shade trees to shelter picnic areas.



4-12A *Appropriate style bench for the more contemporary portions of the LTA Visual Area.*



4-12B-C *The traditional fixture on the left is appropriate for the housing area, while the modern light post on the right is to be used in non-residential areas.*



**SECTION 4.0 Visual Areas****4.3 Shellbank Area**

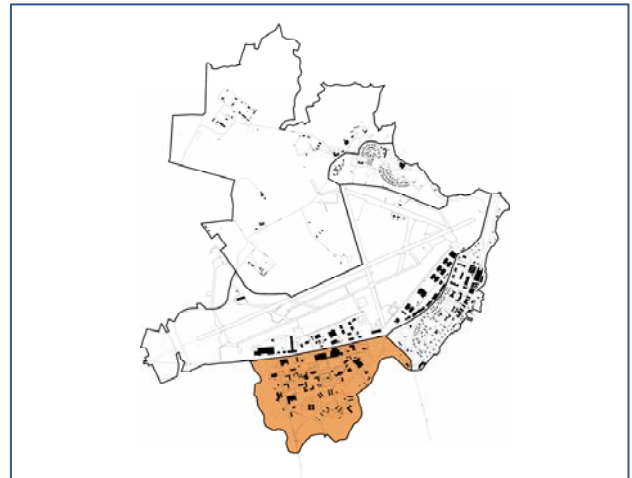
The Shellbank District is located in the south portion of the base between the west aircraft parking apron and the Southwest Branch of the Back River. It is approximately 352 acres.

The Shellbank District's character is the most contemporary area of the base consisting of a variety of building styles and materials. However, one structure (the Contracting Building) is on the National Register of Historic Places.

This area has open space available for development. Several recent buildings begin to establish a trend that coordinates with the other districts. The Base Library, 1+1 Dorms, Eagle Dining Room, the Fitness Center, the Housing Office, Youth Center and the Ryan Center.



4-13A *The library is a good example of the architectural character in the Shellbank Visual Area.*



4-13B *Key Map*



4-13C *Shellbank Visual Area*

**Visual Areas SECTION 4.0****Site Planning**

- Focus on pedestrian circulation and siting buildings to create outdoor spaces.
- Where large parking lots are required, integrate safe pedestrian paths, and break parking into smaller landscaped areas of 50 cars or less.
- Eliminate on-street perpendicular parking where possible.
- Pedestrian access will be developed with walkways and/or landscaping.
- Clustering of buildings to create courtyards and similar outdoor spaces is encouraged (Non-Housing and Flight Line).
- Locate maintenance and trash services in less visible areas, to the rear or side of the building.

**Building Form**

- Maximum height for all buildings, except dormitories, is two stories. Dormitories may be three stories.
- Simple massing is recommended (Non-Housing and Flight Line).
- The presentation of the building form and mass is balanced from the view of the main thoroughfare.
- Building entrances should be easily visible from the street and parking areas.
- Give facades visual interest.
- Locate the main entrance of the building on the principal street.
- Porticos, arcades and colonnades can be used to transition from the building to the site, and recall traditional character without directly repeating features found on historical buildings.



4-14A Maintenance areas are not visible from main entrance.



4-14B Building placement frames outdoor spaces into distinct pedestrian areas.



4-14C Porticos serve as transitional elements from building to site, and emphasize the primary entrance.



**SECTION 4.0 Visual Areas****Roofs**

- In this district further application of standing seam metal roofing and heavy-duty architectural fiberglass shingles is recommended. The standard color for each is a dark brown. The selection of the color (as there is variation in manufacturers and factory lots) requires coordination with adjacent and related buildings due to the openness of the district.
- Large areas of roofing should be made less apparent. Clerestory windows will add interior light and add visual interest to a large roof. Design elements such as dormers, gables and hip should be considered as functional elements for building systems. These also are successful form and mass elements.
- Roofs should have well-defined overhangs and fascia.
- Gutters and downspouts will be dark bronze aluminum.



*4-15A Standing seam dark bronze metal roofs should be used for all non-housing buildings in the visual area.*



*4-15B Large roof planes are broken into smaller areas with dormers, and clerestory walls. Exterior walls are primarily brick, laid in differing patterns, with decorative elements to articulate surfaces.*

**Exterior Walls**

- Walls shall use brick as the primary material.
- Building designs will be expressive of the nature of brick.
- Articulation of the walls shall utilize architectural pre-cast concrete to simulate limestone. The pre-cast units shall be elements such as water tables, plinth blocks, band coursing, lentils, keystones, cornice, coping, sills and etc.
- Provide detail and articulation that is referenced from the LTA and HTA Districts. Interpretations need not be literal; but the source of the inspiration should relate to the existing work.

**Visual Areas SECTION 4.0**

---

**Windows**

- Administration facilities should have insulated windows with bronze tinted, non-reflective glazing. Frames should be anodized aluminum with a dark-bronze finish. Glazing must meet AT/FP requirements.
- Storefront type or pre-manufactured units are acceptable.
- The constraints of the historic districts for matching windows are not mandatory here; however, modern interpretations should draw ideas from the historic references on the base.
- Provide buildings with a portion of window units that are operable. Avoid fixed windows as a complete enclosure; natural ventilation is desirable.



*4-16A Windows should be insulated, with anodized aluminum frames in a dark-bronze finish.*

**Entries**

- Emphasis should be directed toward the entryway of the building. In all new work make a clear and simple statement that identifies where the main entrance to the building is located. This should be achieved by utilizing successful designs and elements currently found on the base. All three districts have adequate examples.
- The entryways may have a porch, a projection, a canopy, and may be detailed with brick pattern work, stone surrounds, and/or medallions.

**SECTION 4.0 Visual Areas****Site Furnishings**

- Trash dumpsters and service area screen walls should be the same material as adjacent structures.
- The site furnishings in this area should complement the larger scaled contemporary structures located within the visual area. The bench used within the HTA and LTA areas is a transitional bench that is recommended for this area as well.
- All site furnishing selections need to be approved by Base Civil Engineer. Figures 4-17A, 4-17B and 4-17C are examples of site furnishings that are appropriate for this area.

**Landscaping**

- This area has an informal site plan; landscape plans in this area should reinforce this aesthetic.
- Landscaping should be used to soften and reduce the scale of the larger building in this visual area.
- Use shade trees to shelter outdoor break areas and picnic areas.
- Annual planting beds should be reserved for use in only the most prominent locations of this visual area, such as the BX entrance.



4-17A Nice transitional style benches.



4-17B Good contemporary light using finish color to match historic lighting on other parts of the base.



4-17C These site furnishings complement the furnishings in this zone in color and level of detail.



**Visual Areas SECTION 4.0****4.4 Flight Line**

The Flight Line Visual Area includes the airfield pavement and the related structures along the south of the airfield. The Flight Line is basically divided in half with one half bordering the Shellbank Area and the other half bordering the HTA Area. The Flight Line has a string of buildings along the HTA that relate very well to that visual area. The facilities within this area are primarily large, light industrial structures.

*4-18A Key Map**4-18B Control Tower is a prominent landmark.**4-18C Flight Line Visual Area*

**SECTION 4.0 Visual Areas****Site Planning**

- Where large parking lots are required, integrate safe pedestrian paths, and break parking into smaller landscaped areas of 50 cars or less.
- Provide break areas that have buffer from the airfield pavement.
- Clustering of buildings to create courtyards and similar outdoor spaces is encouraged.

**Building Form**

- Simple massing is recommended.

**Roofs**

- Standing seam metal pitched roofs. Color to be verified with ICES POC.

**Exterior Walls**

- Brick or metal panels. Color to be verified with ICES POC.
- Metal panel buildings must have a minimum 8' high wainscot of brick.
- The water table, lintels, sill and coping will be precast concrete.

**Doors and Windows**

- Aluminum storefront will be used at primary entrances.
- Anodized aluminum windows with high performance, non-reflective glazing in solar bronze tint.



4-19A Historic hangar.



4-19B Hangars feature a lower wainscot of brick with the upper portions in metal panels.



4-19C Smaller administrative buildings should be primarily brick with a standing metal seam roof.

**Visual Areas SECTION 4.0**

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**Site Furnishings**

- Trash dumpsters and service area screen walls should be the same material as adjacent structures.
- The site furnishings in this area should be very durable and complement the large scaled, utilitarian appearance of most of the structures located within this visual area
- All site furnishing selections need to be approved by Base Civil Engineer. Figure 4-20A shows an example of site furnishings that are appropriate for this area.



4-20A Site furnishings similar to those found in the Shellbank area will complement this zone in color and level of detail.

**Landscaping**

- The airfield area has many restrictions with regard to height limitations and clearances. However, with care, landscaping can still be incorporated.
- Landscaping should be used to soften and reduce the scale of the larger building in this visual area.
- Use shade trees to shelter outdoor break areas.
- Annual planting beds should not be provided within this visual area.
- Plant material on the flightline side of the facilities will enhance the visiting dignitaries' initial impression of the Base. The plant material should be low growing and a combination of evergreen and deciduous shrubs less than 30 inches tall.

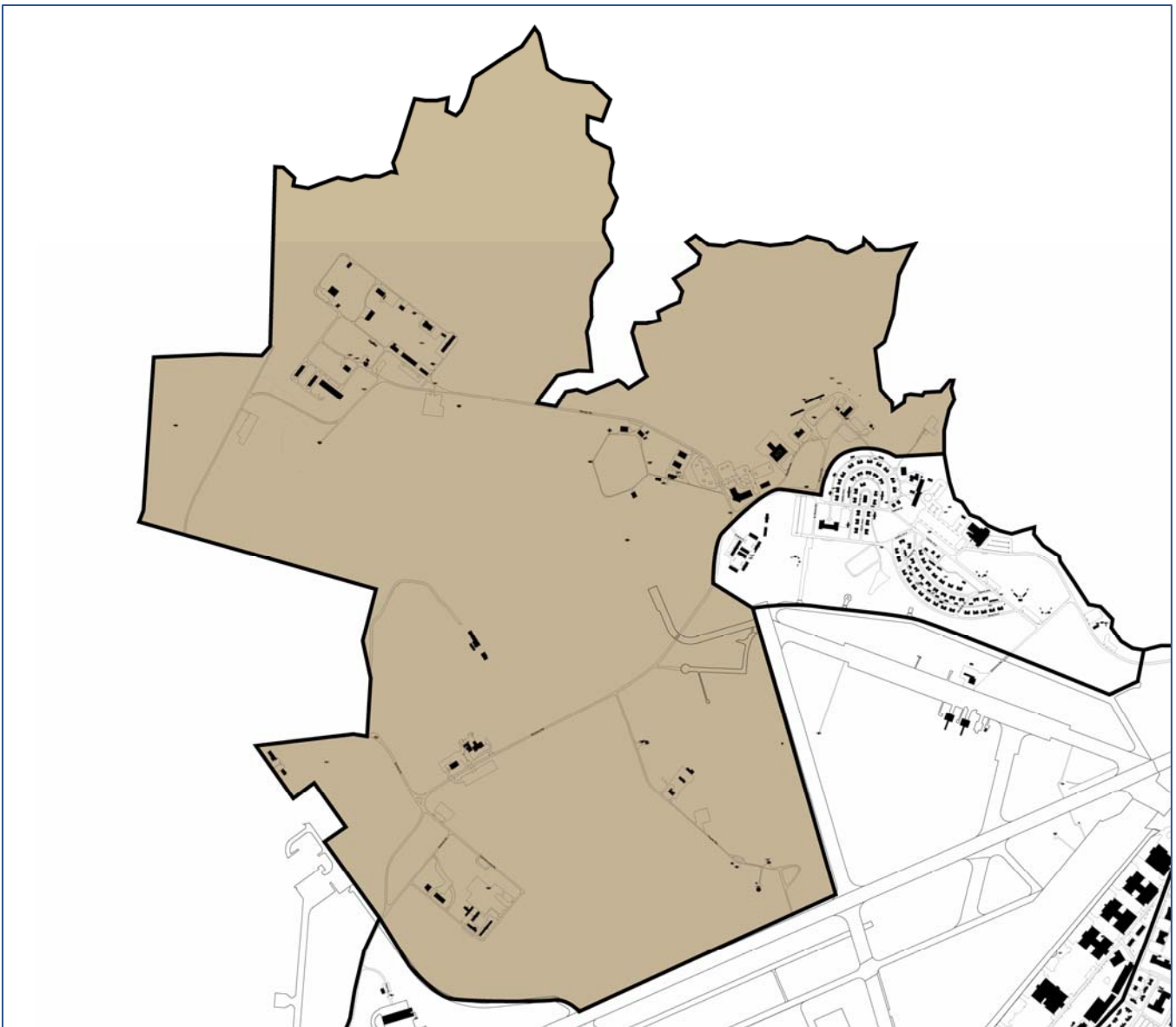


4-20B Low plantings do not interfere with base operations, yet add interest to facilities and pedestrian spaces.



**SECTION 4.0 Visual Areas****5.5 North Base**

The North Base Visual Area is a grouping of a few very different uses; which include a golf course, munitions storage and some administration. There is adequate buffer between these uses. The munitions area aesthetics are dictated by function. The guidelines that follow refer primarily to the golf course and administration areas within this area.

*4-21A Key Map**4-21B North Base Visual Area*

**Visual Areas SECTION 4.0**

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**Site Planning**

- Focus on pedestrian circulation and siting buildings to create outdoor spaces.
- Eliminate on-street perpendicular parking where possible.
- To the extent possible, new development should minimize its impact on this natural environment.

**Building Form**

- Simple massing is recommended.

**Roofs**

- Standing seam metal roofing. The standard color is a dark brown.
- Roofs should have well-defined overhangs and fascia.

**Exterior Walls**

- Brick as the exterior wall material with good use of brick patterns and precast concrete details.
- Provide detail and articulation that is referenced from the LTA and HTA Districts. Interpretations need not be literal; but the source of the inspiration should relate to the existing work.
- The water table, lintels, sill and coping will be precast concrete.

**Doors and Windows**

- Anodized aluminum windows and storefront with solar bronze high performance glazing.
- Provide operable windows in housing, educational, and administrative spaces.



4-22A Buildings utilize simple massing of rectilinear forms. Entrances are articulated with porticos.



4-22B Brick is to be the primary wall material. A standing seam metal roof is standard.

**SECTION 4.0 Visual Areas****Site Furnishings**

- Trash dumpsters and service area screen walls should be the same material as adjacent structures.
- The site furnishings in this area should complement both the administration and golf course area.
- All site furnishing selections need to be approved by Base Civil Engineer. Figure 4-23A shows an example of site furnishings that are appropriate for this area.

**Landscaping**

- This area has a natural open atmosphere. Landscape plans in this area should reinforce this aesthetic.
- Landscaping in open areas should be in natural asymmetrical groupings.
- Provide native landscaping in disturbed areas.



4-23A Site furnishings are modern, and simple in design.



4-23B Plantings are used to highlight building entrances.



4-23C Native plantings are used as buffers and in disturbed areas.



**Visual Areas SECTION 4.0****5.6 Bethel Manor Housing**

Bethel Manor Military Family Housing Area is located 6 miles northwest of the base. This residential satellite facility contains 284 acres and 1,268 housing units. A Housing Privatization Plan requires the demolition of 1,120 units and the subsequent replacement of 1,051 units.

Local services provided include residential family housing for enlisted personnel through Lieutenant Colonels, a shoppette/gas station, a chapel, child care and mini parks.

Housing style is predominated by Capehart, duplex units. Many of these units are two-story. Far fewer residential units are single-story ranchers. All these were built some 40-years-ago and are inadequate to meet today's resident's needs.

Bethel Manor is laid-out in typical suburban fashion. The streets are laid out curvilinear. Electric utilities are above ground. The building architecture style is reminiscent of the late 50's, early 60's. Brick with siding, composition roofs and unenclosed single-car carports dominate.

There is no unifying design scheme throughout. The housing structure groups differ from one another. The all-brick Church structure dominates. The modern shoppette architecture and finish treatments would fit better in a strip mall.

The following pages show images from Bethel Manor. Projects in this area must comply with design standards established in the privatized housing contract (see base housing POC to obtain these standards).



4-24A Bethel Manor Housing Visual Area

**SECTION 4.0 Visual Areas**



4-25A Two-story duplex home



4-25B Two-story row homes



4-25C One-story single family home



4-25D Child Development Center



4-25E Two-story row homes



4-25F AAFES Shoppette Gas Station



4-25G One-story duplex home



4-25H Chapel



Visual Areas SECTION 4.0



4-26A Public Library



4-26B Open Space



4-26C Bethel Manor Elementary School



4-26D Skate Park



4-26E Bethel Manor Youth Center

**SECTION 5.0****Guidelines: Architectural****5.1 Architectural Review****Historical Review**

Most buildings on Langley AFB are eligible for listing on the National Register of Historic Places. Contact the Base Cultural Resource Manager for a complete list of historic structures. This not only affects the HTA and LTA areas but also includes the Contracting Building in the Shellbank Area and several archeological sites. Sensitivity to historic properties must be reflected in future improvements on the base. The standards set forth in this chapter reflect sensitivity to historic building elements, site planning issues and materials.

Projects that involve sites or structures that are listed or are eligible for listing on the National Register of Historic Places are required to go through a Section 106 federal review process. At Langley AFB, the Base Cultural Resource Manager will be responsible for complying with the Cultural Resource Management Plan (CRMP) and for following up on historic reviews. A part of this review includes consultation with the Virginia Department of Historic Resources (VDHR). The VDHR provides information and guidance in historic preservation for the Commonwealth of Virginia and coordinates the Federal preservation program in the state.

There are 2 publications that describe this process:

- *The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings* published by the National Park Service, U.S. Department of the Interior and Project Review in Virginia
- *A Guide for Historic Property Owners, Government Agencies and Private Citizens* published by the Virginia Department of Historic Resources



5-1A Eligible building for National Register of Historic Places.



5-1B Contracting Building in the Shellbank Area (Building 90)



**Guidelines: Architectural SECTION 5.0**

VDHR and Langley AFB together decide whether a particular project has an effect on historic properties. There are three classifications:

- No Effect
- No Adverse Effect
- Adverse Effect.

When it is determined what classification of impact a project will have, procedures to avoid or mitigate adverse effects need to be developed. The review process is complete when an agreement has been reached through the State Historic Preservation Office (SHPO), and a permit is issued by the federal agency. A separate permit is not issued by VDHR. It should be noted that this review process cannot stop a project but may result in revisions.

For more information, contact:

Base Cultural Resources Management  
1 CES/CECP  
37 Sweeney Boulevard  
Langley AFB, VA 23665

**Preservation Issues**

All work performed in the historic areas shall be mindful of the importance of maintaining the historic character. The CRMP describes requirements, procedures, and methods for historic preservation; consult the CRMP prior to commencing any work in the historic areas. Over the years, a number of renovations, additions, modifications and up-grades have been performed on the LTA and HTA District buildings. The majority of this work has been to the detriment of the historic fabric; however, it is fortunate that the character of the area is discernable, desirable, and retrievable. Clearly, future work around, or on, or in the buildings (and spaces) of these areas must maintain and restore the character. The proportions, elements, materials, style, and forms establish a rich and well-defined vocabulary for design at Langley Air Force Base.



5-2A Intricate brickwork.



5-2B Embedded medallion.



5-2C Intricate brickwork and overhang.



**SECTION 5.0 Guidelines: Architectural****5.2 General Requirements**

In conformance with ACC policy, when the floor area of an addition is less than 25% of the existing building floor area, the addition should be designed to match the existing building, unless otherwise instructed by the Base Civil Engineer.

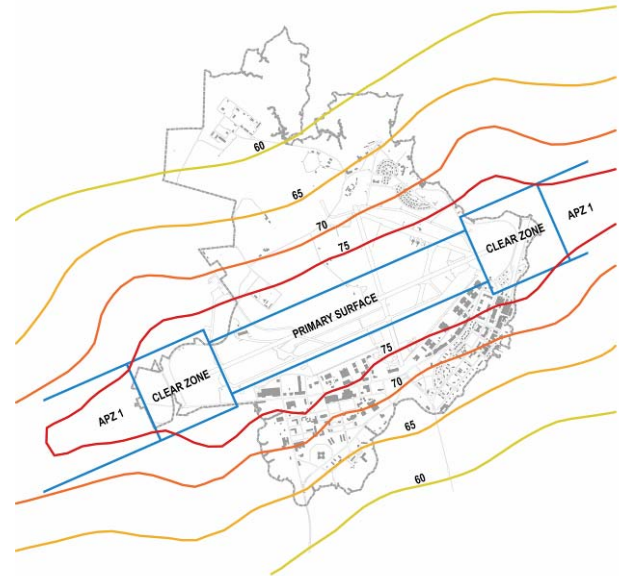
Building finished floor elevation shall be not less than 9 feet above Mean Sea Level (MSL). Concrete pads erected for the installation of transformers, switchgear, mechanical equipment, and substations shall adhere to the same standard.

**Air Installation Compatible Use Zones (AICUZ)**

The AICUZ Program designates areas where certain structures have the potential to obstruct airspace or otherwise be hazardous to aircraft operations. It also includes areas where occupants could be exposed to the health, safety, or welfare hazards of aircraft operations. Specifically, the AICUZ includes:

- Noise Contours, which are derivatives of computerized Day-Night Average Sound Level (Ldn) data (see figure 5-3A).
- Clear Zones and Accident Potential Zones (APZs) are statistical limits based on past Air Force aircraft accident events (see figure 5-3A).
- Certain areas designated by the Federal Aviation Administration (FAA) and the Air Force where there are height limitations in the approach and departure zones of the base.

The only real property interest that the United States Air Force has requested and received authorization and appropriation to acquire is the area designated as the Clear Zone. Compatible land use controls for the remaining airfield environs are recommended to be accomplished by local governments and have been incorporated into local land use planning and control processes.



5-3A Map showing noise contours, clear zones, and accident potential zones.

**Guidelines: Architectural SECTION 5.0**

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Like most military installations with airfield operations, Langley AFB is beginning to feel the impacts of off-base land development. Experience has shown that when unguided development infringes upon an airfield's accident potential areas and/or high noise zones, the impacted groups soon seek relief. This can range from the imposition of "quiet hours" to the complete closure of a facility. Conversely, it needs to be recognized that the public must be protected from the noise and danger inherent in air base operations.

**Noise Contours**

Studies on residential aircraft noise compatibility recommend no residential uses in noise zones above Day-Night Average Sound Level (Ldn) 75, or its equivalent in other noise descriptor systems.

Commercial/retail trade uses as well as personal and business services are generally compatible without restriction up to Ldn70. Between Ldn70-80, attenuation should be included in the design and construction of buildings.

The nature of most uses in the public and quasi-public services category requires a quieter environment, and attempts should be made to locate these uses below Ldn65, or else provide adequate attenuation.

Although recreational use has often been recommended as compatible with high noise levels, it is now believed that above Ldn75, noise becomes an impeding factor. Where the requirement to hear is a function of the use (music shell, etc.), compatibility is limited. Buildings associated with golf courses and similar uses should incorporate noise attenuation.

Designers of new projects within the Noise Contour Areas should contact the Base AICUZ Program Manager for specific restrictions.

**Clear Zones and Accident Potential Zones**

Of the three planning determinants previously cited, accident potential is perhaps the most critical, but also in the past, has been the least defined. Accident potential, as discussed here, refers to where most accidents have occurred in the past at Air Force bases.

The analysis of aircraft accident history focuses on determining where an accident will likely take place and the severity of the resulting impact. Clear Zones and Accident Potential Zones have been designated at both ends of the Langley AFB runway.

Within the Clear Zone Area, the overall risk is so high that the necessary land use restrictions would prohibit reasonable economic use of the land. As stated previously, the Langley AFB Clear Zone Area is now owned by the Department of Defense, thus acquisition actions are no longer required; however, no new structures should be allowed in this area.

Accident Potential Zone I (APZ I) is less critical than the Clear Zone, but still it possesses a significant risk factor. This 3,000 foot by 5,000 foot area has recommended land use compatibility guidelines that are sufficiently flexible to allow economic use of the land. APZ II, which is 3,000 feet wide, 7,000 feet long, and extends 15,000 feet from the runway threshold, also has some risks associated with it, though less than APZ I. About 25% of all accidents occur outside the Clear Zone and Accident Potential Zones.

Designers of new projects should contact the Base AICUZ Program Manager for specific restrictions.

**Guidelines: Architectural SECTION 5.0**

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**Height Obstructions**

Height obstructions are a major consideration when evaluating planning issues related to airfield/airspace operations. For this reason, Langley AFB and the FAA have set guidelines for local communities to follow. Specific information regarding height limitations can be obtained through the Base Community Planner, 1CES/CECP.

As a result of these guidelines, the following uses should be restricted and/or prohibited:

- Uses that release into the air any substance which would impair visibility or otherwise interfere with the operations of aircraft, e.g., dust and smoke.
- Uses that produce light emissions, either direct or indirect (reflective), which would interfere with pilot vision.
- Uses which produce electrical emissions that would interfere with aircraft communication systems or air navigational equipment.
- Uses that would attract birds or waterfowl, such as, but not limited to, operation of sanitary landfills or maintenance of feeding stations.

**Code Requirements**

All new structures, renovations, and base improvements shall meet the requirements of the most recent International Building Code (IBC), *UFC 3-600-01 DoD Design: Fire Protection Engineering for Facilities*, *NFPA 101: Life Safety Code*, *UFC 1-200-01 DoD Design: General Building Requirements*, and *UFC 4-010-01 DoD Design: DoD Minimum Antiterrorism Standards for Buildings*. All buildings shall comply with the Uniform Federal Accessibility Standards (UFAS), and the Americans with Disabilities Act (ADA). The Virginia Uniform Statewide Building Code (VUSBC incorporating BOCA) does not have jurisdiction.

**SECTION 5.0 Guidelines: Architectural****5.3 Site Planning****Land Use**

- All site planning should be in conformance with the *Langley General Plan*.
- Facility design shall incorporate energy-efficient siting and should be compatible with the existing natural environment.
- Refer to the *Langley General Plan* for regulations on noise reduction, particularly in areas surrounding the flight line.

**Site Development Pattern**

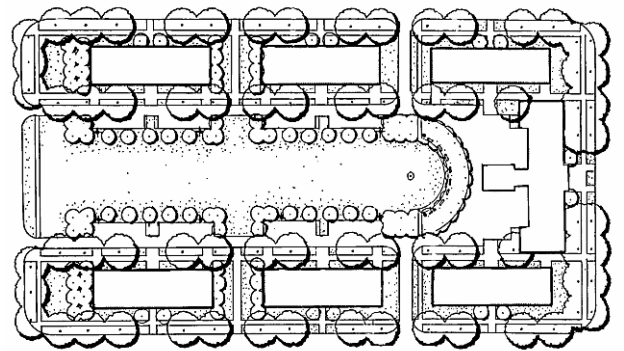
- Arrange buildings in tight groupings, which share parking and encourage people to walk between buildings.
- Where possible, integrate new buildings into existing groupings.
- Areas between buildings should be designed as exterior pedestrian spaces.
- Use building forms, landscaping, and existing topography and wooded edges to enclose outdoor spaces.
- Configure site to separate service zones from parking and pedestrian spaces. Screen service areas from major streets.
- There are several means for siting buildings; one is grouping buildings in associative clusters providing a sense of community. This creates inviting outdoor spaces. When carefully considered and planned, these clusters will establish a route for pedestrian traffic by creating nodes as destination points. This provides the opportunity to be a little less formal. Where a formal setting is appropriate, buildings should be sited square to the main thoroughfare. Walkways and entries that are symmetrical will reinforce a formal design.



5-7A Well designed pedestrian area between Buildings 587 and 586.



5-7B Example of an informal building arrangement.



5-7C Example of a formal building arrangement.

**Guidelines: Architectural SECTION 5.0**

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**Setbacks**

- Setbacks are determined by AT/FP requirements. Building front yard and side yard set backs, in most cases, should match that of adjacent and neighboring buildings.

**Environmental Stewardship**

- Site planning should minimize the negative impact on the natural environment.
- Design facilities to work within the existing topography; preserve as many large trees as possible.
- In undeveloped forest areas, configure the site layout to retain large parcels of wooded habitat.
- Avoid development in the wetlands. Refer to the General Plan for wetland locations.
- Refer to Landscape Design Guidelines (Section 7.0) for identification and protection of landscape features.

**Future Development**

- Where the possibility of facility expansion exists, the building site plan should show the proposed method of expansion (addition or separate building).
- Coordinate location of underground utilities, parking and service areas to minimize impact on future growth.
- Locate new electrical power lines underground whenever possible.



**SECTION 5.0 Guidelines: Architectural****5.4 Building Form****General**

- Use of simple massing and sloped roof forms is recommended.
- Maximum height for all buildings, except dormitories, is two stories. Dormitories may be three stories (see Figure 5-9A).
- Arrange building forms to create outdoor pedestrian spaces where possible.
- Use porticos, arcades and colonnades to provide shade and transition building to site (see Figure 5-9B).

**Style**

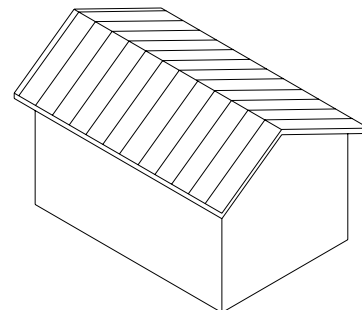
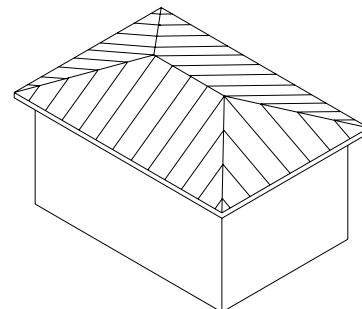
- Traditional design concepts of balance, proportion, and tripartite (base-middle-top) facade organization will create compatibility with the historic architecture. This should be done without the use of direct stylistic imitation.
- The use of porticos, arcades or colonnades can be used to recall the traditional architecture on the base. This should be done without directly repeating features found on historic buildings.

**Industrial Buildings**

- Use simple functional forms for industrial buildings.
- Incorporate smaller additive forms to give human scale to large building masses.

**5.5 Roofs****Form**

- Roof forms of gable or hip designs are preferred (see Figure 5-9C).
- One main roof form should be used throughout a building. A secondary roof form may be used if needed.

*5-9A Dormitory facility.**5-9B Entry portico.**GABLE**HIP**5-9C Basic roof types.*

**Guidelines: Architectural SECTION 5.0**

- Drainage should be taken into consideration when designing roof additions and slopes.
- Roof overhangs and edges are important character defining elements and should be compatible with adjacent buildings. Eaves should be 18 to 24 inches in distance. The fascia should be no less than six inches.

**Slope**

- ACC policy requires sloped roofs, 3:12 minimum recommended.
- Very large buildings and hangars may have slopes as low as 1:12 with the approval of the Base Civil Engineer and ACC.
- The roof slope should be consistent throughout a building. This includes canopies, porches and other roofed elements.

**Roof Material**

- Structural Standing Seam Metal Roofing (SSSMR) is preferred in most applications that are not in the proximity of a historic building exhibiting another roof material.
- On all but the larger industrial/ mission support buildings, the roof colors shall be dark bronze to match that used predominantly throughout the base (verify color with 1CES POC).
- Large-scale buildings along the flight line may have a light gray metal roof when the slope is less than 2:12 and not visible from normal ground-based sight lines (verify color with 1CES POC).
- Similar building types should use similar roofing materials.
- Refer to the Exterior Material Matrix on page 1-2 for acceptable roof materials in all areas.



*5-10A Dark bronze standing seam metal roofs are preferred in most applications that are not in the proximity of a historic building exhibiting another roof material.*



**SECTION 5.0 Guidelines: Architectural****Roof Warranties**

Roof material, finish and workmanship shall be fully warranted for the following time periods:

- Metal roof: Fluoropolymer (e.g. Kynar 500) factory finish, 20 years. Warranty includes water tightness and finish.
- Asphalt Shingles: 30 years.
- Slate, Clay, and Concrete Tile: 50 years.
- EPDM, Modified bitumen, Built-up roof: 20 years.

**Gutters and Downspouts**

- Rain diverters or gutters and downspouts must be provided over building entrances.
- In heavily wooded areas, take maintenance into consideration when designing roof drainage.
- Where low-slope roofs are permitted, the roof should be drained to the exterior walls. Rain leaders should be used in lieu of exterior downspout conductors.
- Downspouts will be provided with splashblocks. Locate splashblocks to avoid conflict with pedestrian circulation.
- Concealed gutters and downspouts are preferred on the outside of the building line.
- Coordinate the material and color of gutters and downspouts, with roof and wall materials.
- Provide a means of protecting downspouts from being damaged or crushed in high traffic areas.



5-11A Gutters and drainpipes.

**Guidelines: Architectural SECTION 5.0****Rooftop Equipment**

- Equipment should not be mounted on the roof.
- *Exception for Flat Roofs:* Rooftop equipment may be used on flat roofs only if alternate locations for equipment are economically prohibitive. When rooftop equipment is used, it must be placed out of view on all sides of the building, and factory-painted light gray. Use of rooftop equipment requires Base Civil Engineer and ACC approval prior to 10% design stage. Very few exceptions will be granted. Even with approval of rooftop equipment, owner will be required to fund equipment maintenance and roof maintenance for the life of the facility.
- All roof penetrations and exposed flashing shall be factory finished to match the roof color. Any elements that cannot be factory finished will be field painted to match the roof color.
- Roof penetrations should be made on the least visible sides of the roof, rear or side elevations. Penetrations should be kept to a minimum.

**5.6 Entrances****Visibility**

- Each building entrance must be readily identifiable.
- At least one building entrance must be clearly visible from the main viewing street and the parking area.

**Entry Sequence**

- Facility design should address the entire entry sequence beginning with vehicular/pedestrian circulation routes and terminating in the building lobby.
- Where both a front (street) and a back (parking) entrance are required, the entrances should share a common lobby.



5-12A Main building entrance is well defined.



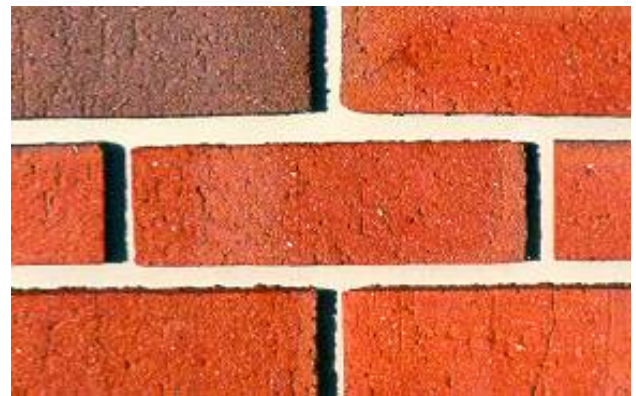
5-12B Building entrance is clearly visible from main viewing street.

**SECTION 5.0 Guidelines: Architectural****Protective Cover**

- All exterior entrance doors must have at least 3'-0" of protective cover.
- Roof overhangs, recesses, colonnades or other integrated elements may be used.
- Separate elements applied to the exterior walls (example: cantilevered or bracketed canopies or glass roofed vestibules) are discouraged.
- Fabric canopies on new buildings are not acceptable.

**5.7 Exterior Walls**

- Brick is the preferred material. Custom blend bricks are used on existing buildings in the HTA renovations. Brick units, which more appropriately blend and coordinate with the general nature of the existing brick, are listed as follows:
  - "Garden Blend-A" #95-20 by Belden Brick Co., Canton, Ohio (Figure 13A, top)
  - "Stratford Flashed Range" #337 by General Shale Brick, Somerset, Virginia (Figure 13A, middle)
  - "Midlothian" #1-111A by Lawrenceville Brick Corp., Lawrenceville, Virginia (Figure 13A, bottom)
  - "Poplar Forest Shenandoah Series" by Old Virginia Brick Co., Salem, Virginia (not shown)



5-13A Brick samples:  
 Top: Garden Blend –A  
 Middle: Stratford Flashed Range  
 Bottom: Midlothian



**Guidelines: Architectural SECTION 5.0**

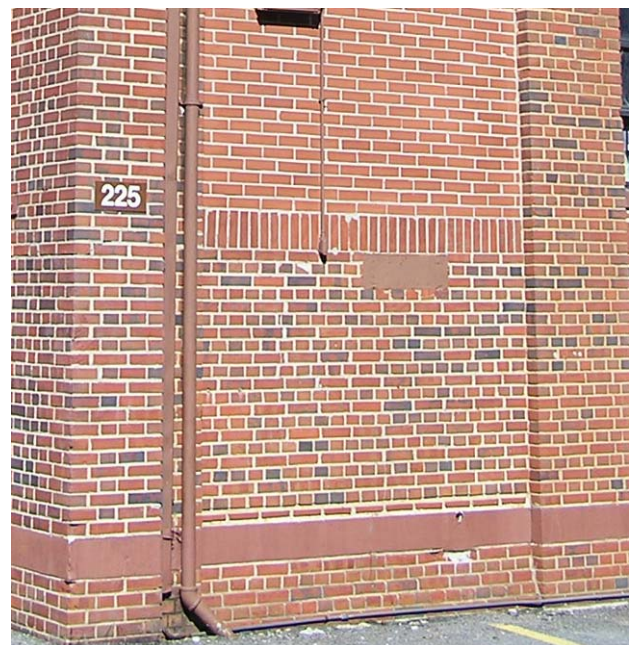
- Mortar color shall be coordinated with the base design office for final selection. In most new construction (particularly in the Shellbank Area), facilities are constructed with Lawrenceville #1-111A brick; mortar color shall be Lehigh 00024 (24A HAZELNUT) or Riverton's Flamingo C-73, and the color of the brick veneer elastomeric construction joint sealant shall be Pecora's Redwood Tan. The base design office shall approve the final selection.
- Brick, mortar color and joint profile shall match existing when brick veneer repairs or additions to existing structures are accomplished.
- In new construction, mortar joints should be tooled concave or tooled vee. Many of the historic structures have a raked joint, which is distinctive, but it is prone to weather resistance problems. The vee joint is a viable substitute.
- An important element of the brick wall is the bond pattern, especially in historic areas where the character is strongly influenced by the brick bond. All new buildings should utilize a header bond pattern.
- The use of the running bond should be minimized. It is noted in several places, particularly on building additions. All additions should match the brick bond of the parent building.
- Acceptable brick bond patterns include these header bonds:
  - Flemish
  - English
  - Common w/6th course headers
  - Common w/6th course Flemish headers.



5-14A Brick bond pattern - Common with 6th course headers



5-14B Brick bond pattern - Flemish



5-14C Brick bond pattern - English below with an inappropriate infill of running bond above

**SECTION 5.0 Guidelines: Architectural**

- The use of a water table and precast masonry architectural elements in a building façade is encouraged. Precast finish shall have salient characteristics similar to the following fabricators' precast material:
  - Seaboard Concrete, #7224/Bermuda Beige with a Machine Honed Finish
  - Riverside, Architectural Stone, Old English Limestone, Heavy Acid Etch
- Large-scale buildings such as a warehouse or aircraft hanger may require a more economical wall material than brick. These buildings normally relate to and are associated with industrial/mission support areas of the base. Vertical metal wall panels such as those utilized in pre-engineered buildings are appropriate. To lessen the visual impact of these large wall systems, provide a brick wainscot that is one-fourth to one-third the height of the wall (a minimum of four feet). This will establish a visual foundation for the large-scale building and allow the building to coordinate with the rest of the built environment.
- Stucco is found intermittently on the base. It is an element in the character of the historic areas however, its current use is only permitted for repairs and additions of existing stucco buildings.

**Materials**

- Refer to the Exterior Material Matrix on page 1-2 for acceptable wall materials in all areas.



*5-15A The Bateman Library is a good example of the desired design, proportion, and profile for the water table and other precast masonry architectural elements.*



*5-15B The use of stucco on the Base is limited to repairs and additions of existing stucco buildings.*



**Guidelines: Architectural SECTION 5.0****5.8 Doors and Windows****Design**

- Design building fenestration for user comfort and energy efficiency. Reduction of cooling loads is critical during Langley's hot summer months.
- As a minimum, provide operable windows in residential, educational, and administrative spaces. Specify insect screens and accessible hardware.
- Orient windows to take advantage of cross ventilation.
- Incorporate overhangs, porches, colonnades, insulated high performance glazing and other strategies to block direct summer solar gain.
- Use north facing clerestory windows and other natural lighting methods to reduce lighting demand and associated cooling load.

**Materials**

- Windows should have brown, aluminum, thermal-break frames. Finish should be anodized with minimum 5-year warranty.
- Glass should be insulated, solar bronze tint, with minimum reflectance. Due to summer cooling loads, consider high-performance glazing where feasible.
- For historic buildings the style and profile of new and/or replacement windows shall match the original window (consult the base *Cultural Resource Management Plan (CRMP)*).
- The use of painted wood is discouraged, it is preferred that frames, molding and trim are wood clad in pre-finished aluminum.
- When retrofit storm windows are selected, provide units that compliment the existing window.



5-16A The new dorms have loggias that will block direct solar gain on the windows.



5-16B The windows on Building 602 are operable, have anodized aluminum frames, and are articulated with precast masonry details.

**SECTION 5.0 Guidelines: Architectural**

- Articulate the jamb and the head of windows with brick details or architectural precast concrete surrounds. Jack arch lintels and key stone lintels are acceptable.
- *Exception:* Windows in family housing shall be aluminum. Glass in housing should have minimal tint.
- Exterior Doors and Frames: Specify steel doors and frames for all exits, work shops and mechanical/electrical rooms. Hollow metal doors and frames shall be used at entrances and should be galvanized and field painted (verify color with ICES POC).
- Aluminum storefront doors should be used at primary entrances.
- Refer to the Exterior Material Matrix on page 1-2 for acceptable window and door materials in all areas.



5-17A The Bateman Library has appropriate aluminum storefront doors at the main entrance.

**5.9 Finish Hardware**

- All locks at Langley Air Force Base shall be compatible with Best Grand Master locking system. Hardware shall meet the requirements of the Americans with Disabilities Act Accessibility Guidelines in all community buildings and public buildings.
- Keying shall be compatible with the existing Langley AFB master keying system.
- Locks should have interchangeable cores.
- Designers must consult with Base Civil Engineer prior to writing the specifications.

**Guidelines: Architectural SECTION 5.0**

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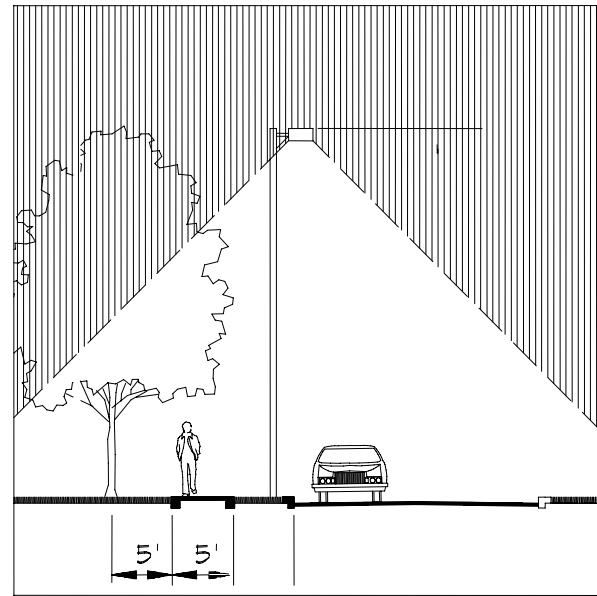
**5.10 Miscellaneous Paint**

- Minimize the use of exterior materials that require painting.
- The palette for the base consists of two hues, a medium-range brown known popularly as Langley Brown (Federal Standard 595B\_20100) and an off-white known as Langley Special Beige (verify color with ICES POC).
- To minimize the variation in the appearance of the paint finish, follow these guidelines:
  - Consistently use a single manufacturer and formulation.
  - Schedule painting to include an entire building exterior or groups of visually associated buildings and equipment (spot painting greatly increases the possibility of highlighting slight variations in hue.)
- ACC policy will reduce the amount of painting. A regular schedule for maintaining all painted surfaces in good condition is required. Regardless of the item or of the location, if poor paint condition is present, it prevents the improvement of the visual appearance of any given area.

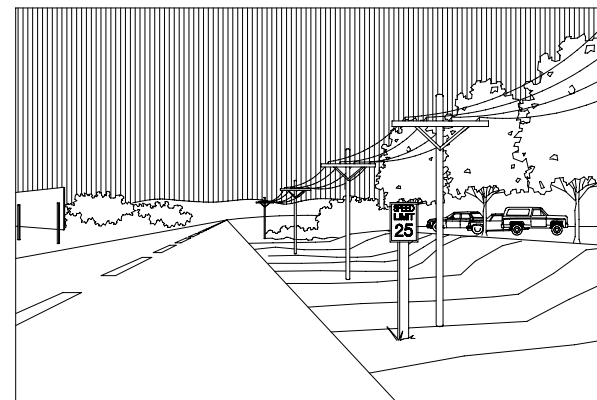


**SECTION 6.0****Guidelines: Site Design****6.1 Vehicular Circulation**

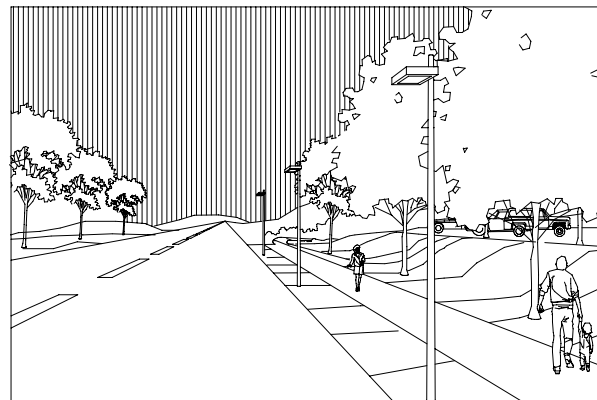
- Ensure new streets follow the tradition of streetscapes developed in the Historic District by providing street lighting, sidewalks, and street trees (Figure 6-1A).
- Provide curb and gutter at all new pavement.
- Minimize use of wheel stops. Reserve their use for instances where they will prevent vehicles from damaging trees or encroaching on to walkways.
- Separate vehicular and pedestrian circulation at major pedestrian routes.
- Locate utilities underground in cantonment areas. In all other areas, locate utilities underground where feasible (Figures 6-1B and 6-1C).
- Minimize curb cuts.
- Site design shall conform to the requirements of *Americans with Disabilities Act (ADA)*, *Uniform Federal Accessibility Standards (UFAS)* and *UFC 4-010-01 - DoD Minimum Antiterrorism Standards for Buildings*.



6-1A Street lighting and sidewalks improve safety and appearance.



6-1B Streetscape before improvements.



6-1C Streetscape improved with underground utilities, sidewalks, lighting, and street trees.

**Guidelines: Site Design SECTION 6.0****6.2 Parking****Siting**

- Design parking areas to provide a safe, functional layout and reduce the visual impact of parked cars.
- Site parking areas around the perimeter of building groups.
- Do not locate parking between a building and the main viewing street (Figure 6-2A). A campus setting is best achieved where automobiles are not stored in front of the buildings.
- Do not let parking occupy pedestrian spaces between buildings in a group.

**Screening**

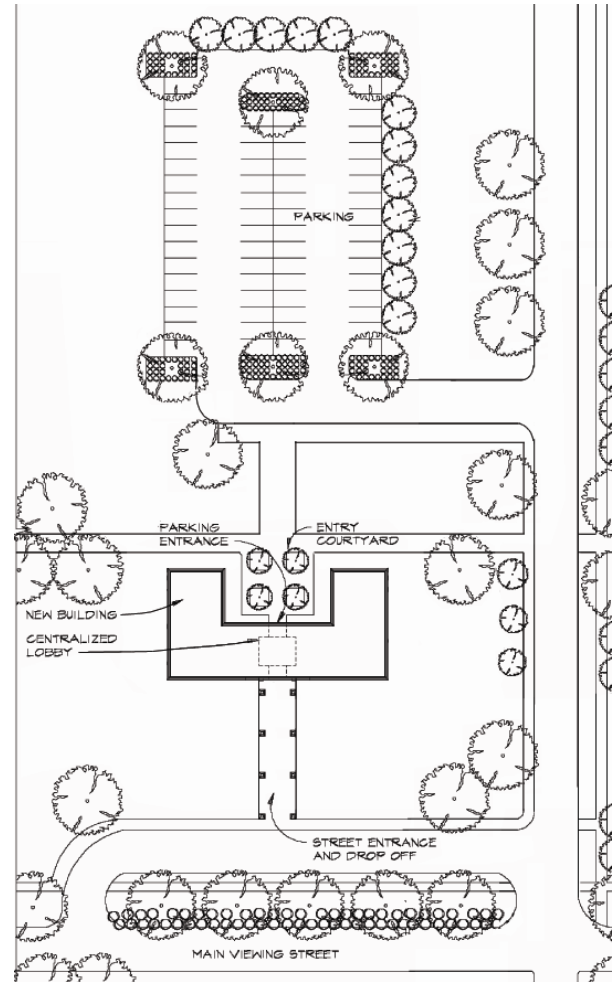
- Use buildings, natural topography and landscaping to screen parking from main streets.
- Subdivide large parking areas into lots of 50 cars or less, where feasible, incorporating landscaping between lots. Small parking areas reduce the negative visual impact and allow opportunity for additional landscaping.
- When developing parking areas, try to save as many desirable existing trees and shrubs as possible.
- Eliminate on-street parking where possible.

**Pedestrian Paths**

- Provide safe pedestrian paths from parking to building entrances.
- Provide handicap accessible parking spaces and accessible routes to the building in conformance with ADA and UFAS.

**Services**

- Separate service/dumpster locations from pedestrian circulation. Ensure turnaround space for fire trucks and service vehicles.



6-2A Example of good site planning.



6-2B Provide safe pedestrian paths to and from parking and building entrances.

**SECTION 6.0 Guidelines: Site Design****Landscaping**

- Use shade tree plantings at parking lots to reduce glare and moderate the ambient air temperature on the lot.

**Curbs**

- Provide curbs around parking, access roads and streets.
- Typically curbs should be concrete with a 6-inch high street-side face and a 6-inch top face. Provide integral curbs and gutters.
- Some curbs in the HTA and LTA have a unique rounded profile or a lower profile to the street; new work that relates to these profiles shall match.



6-3A Safe, convenient paths will encourage pedestrian traffic.

**6.3 Pedestrian Circulation****Paths**

- Provide safe, convenient paths to encourage bicycle and pedestrian circulation (Figure 6-3A).
- Design continuous paths linking buildings, courtyards, parks, and other activity nodes (Figure 6-3B).
- Provide bike paths with the roadway or create separate bike path/jogging trails.
- Separate vehicular and pedestrian circulation.



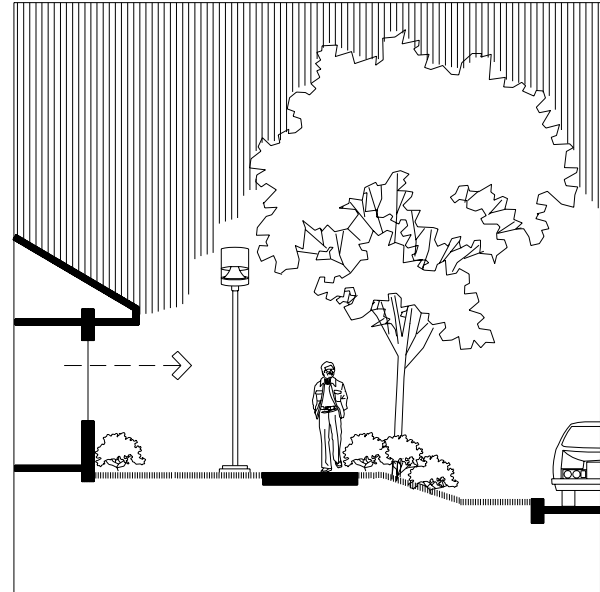
6-3B The dorms have a well designed circulation system of continuous paths linking buildings, courtyards and other activity nodes

**Guidelines: Site Design SECTION 6.0****Sidewalks**

- Add sidewalks to existing roadways where possible. New roads in developed areas should have sidewalks on both sides of the road.
- Sidewalks shall be a minimum 4'-0" wide. Concrete color: Miami Buff
- Set sidewalks back an appropriate distance from the curb edge to prevent placement above utility areas and allow for landscaping and maintenance.
- Exposed aggregate to be used for ADA accessible curb ramps.
- In locations requiring a more special appearance, brick or concrete pavers shall be used. The color shall be "brick red." Units that are 4"x8" nominal are recommended. Units shall be installed with the tight joint (swept sand) method and a compacted cementitious sand subbase. A metal or concrete retaining edge is recommended. The pattern should typically be a running bond or a stack bond. Where appropriate, special patterns or shapes may be used.

**Landscaping**

- Promote security: Configure paths and design landscaping to permit surveillance of pedestrian circulation routes (Figure 6-4A).
- Provide shade trees along paths (Figure 6-4B).
- Provide low-maintenance, vandal resistant seating and drinking fountains at intervals along paths.



6-4A *Passive surveillance of paths from buildings increases pedestrian safety.*



6-4B *Provide shade trees along paths.*



**SECTION 6.0 Guidelines: Site Design****6.4 Site Lighting****Basewide**

- Create a unified appearance on base by selecting light fixtures of a similar design and lamp type.
- Fixtures shall be low maintenance and vandal resistant.
- Low level path lighting may be provided by using bollard type fixtures in dark bronze metal finish.
- High pole lighting, 50 feet and higher, for large areas such as ball fields, large area parking, and the flight line is very specialized and not subject to much variation in regard to aesthetics. Typically the necessity is the overriding factor.

**HTA and LTA Visual Areas**

- Streets, paths, and parking lots shall be illuminated using vintage fixtures similar to other adjacent fixtures (Figure 6-5A).

**All Other Visual Areas**

- Streets and parking lots shall be illuminated by fixtures mounted on tapered metal poles, 25-40' high. The fixture shall be rectangular cutoff (shoebox type) fixtures or alternate fixtures compatible with the surrounding architecture and existing fixtures. Color shall be dark bronze.
- Pedestrian circulation and area lighting shall use rectangular cutoff (shoebox type) fixtures or alternate fixtures compatible with the surrounding architecture and existing fixtures. Fixtures shall be mounted on 12' to 15' metal posts. Color shall be dark bronze. (Figure 6-5B)



6-5A Vintage light fixture for use in the historic areas.



6-5B Light fixture for use in all areas, except historic.

**Guidelines: Site Design SECTION 6.0****6.5 Fences and Screens**

- On-base security fencing will be a steel picket fence with masonry/brick columns.
- Provide screening around mechanical equipment, storage areas, trash dumpsters and other visually objectionable items.
- The materials for screens shall match the building or buildings with which the equipment is related either visually, functionally, or both.
- In residential areas, wood or wood/brick combinations are acceptable.
- In administrative and community building locations, brick with appropriate detailing is preferred. Wood, appropriately used, is acceptable.
- Industrial areas shall use brick or wood in more public areas, and metal board fencing in less accessible areas.
- Wood screening, fencing, and gates should be redwood, douglas fir, or pressure treated southern yellow pine. Opaque exterior stain or paint should be applied as a finish. Boards shall be nominal 6" wide and installed vertical in an alternating pattern or solid side pattern. The base should begin to phase out the use of the horizontal woven wood fencing.
- All wood or masonry screens should terminate the top of the wall with a cap or coping for a finished appearance.
- All applications for screening can be augmented by selective use of landscape materials. Plantings assist in blending a screen into the landscape.
- Provide vehicle access to mechanical equipment areas. Access may be provided by paving or reinforced sidewalk where feasible.
- Equipment screens should allow required clearance for equipment maintenance, removal, and airflow. Provide vehicle access to mechanical equipment areas where feasible. Pavement or reinforced sidewalks are acceptable for vehicle access.



6-6A Example of a metal and masonry fence.



6-6B Example of a masonry fence.



6-6C Example of a masonry dumpster enclosure with gate.



**SECTION 6.0 Guidelines: Site Design**

- Dumpsters should be screened with 3-sided enclosures. For dumpsters located in prominent areas, provide gates as directed by Base Civil Engineer. Doors should be located away from view of primary streets. Minimum height of walls should be 6" greater than dumpster height. Provide paved vehicle access and 6" diameter concrete filled pipe bollards to prevent damage to walls (Figure 6-7A).

**6.6 Site Furnishings**

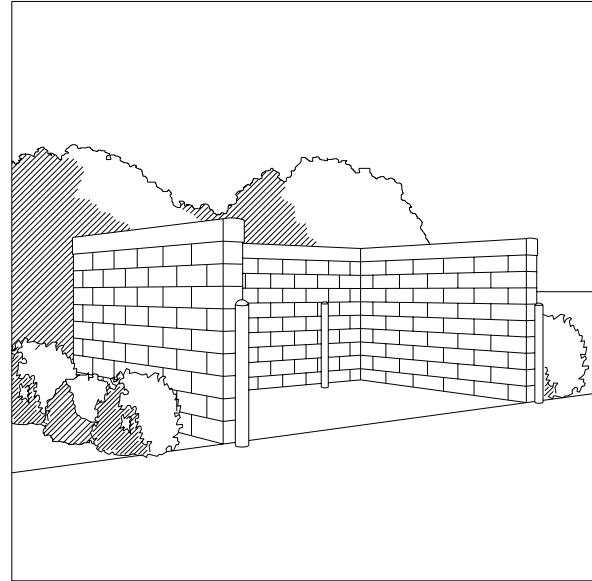
- Develop a coordinated basewide approach to site furnishings. This includes trash receptacles, ash urns, benches, tables, mailboxes, drinking fountains, bus shelters, kiosks, flagpoles, bike racks and picnic shelters.
- Furniture should be comfortable, durable, vandal resistant and easily maintained.
- Site furnishings shall be accessible to the handicapped requirements of ADA/UFAS.

**Materials and Colors**

- Furniture colors and materials should complement the surrounding architecture.
- Use of recycled materials is encouraged where feasible.
- See visual areas (Section 4) for colors and materials specific to each area.

**Location**

- Locate tables and benches where they will receive shade in summer months. This is especially important when using metal or concrete furnishings.
- Create small pedestrian pockets along paths by grouping together picnic tables, benches, trash receptacles, and paving. Develop the surrounding landscape to define the space and provide shade.



6-7A The use of masonry screen walls and concrete-filled bollards is recommended for dumpster enclosures



6-7B Group site elements together.



6-7C Locate benches along pedestrian paths.

**Guidelines: Site Design SECTION 6.0****Park Benches**

- Should be anchored on a concrete pad.
- In most cases, the color should be black or brown.

**Bicycle Racks**

- Bike racks shall be anchored to a concrete pad large enough to accommodate both the bicycle and the rack.
- Locate bike racks convenient to building entries, but not in prominent, highly visible areas or provide a screen.
- Dormitories and community buildings may have many bicycles and are prone to a disorganized appearance. Providing an adequate quantity of rack space helps avoid that occurrence. A screen and/or shelter will conceal it.

**Trash Receptacles**

- All receptacles shall have a liner for easy disposal of waste.
- Attempt to always place receptacles on a concrete pad. In areas where receptacles may be overturned by wind or mischief, anchor receptacle to the concrete pad.
- Locate trash receptacles where it is convenient for both receiving and disposing of waste.

**Picnic Tables**

- A specific base-wide style is not mandated; instead in the areas where picnic tables are used (community areas, parks, dormitory yards, break areas, etc.), the tables must all be of the same style in that area.
- Maintain tables in good repair and with fresh finishes. A yearly application of paint or stain is recommended.
- At all locations, keep the tables in a neat and orderly arrangement. A concrete pad is recommended for the tables.



6-8A Bike racks near dorm area.



6-8B Picnic tables used at the dorm area complement the other site furnishings used in the area.



**SECTION 7.0****Guidelines: Landscape Design****7.1 General**

- The following guidelines are adapted from AF Landscape Design Criteria. In addition, the base has pertinent landscape study documents that are applicable to this section (see 1CES POC to obtain these documents).
- All landscape plantings should comply with the Base's Land Management Plan (provided as Appendix B)
- Landscapes should be functional as well as visual.
- Selecting the appropriate plant material for site conditions will reduce maintenance.
- Provide a landscaped space uncluttered by vehicles in front, at the entrance, and between the main viewing street and the building.
- Use landscape to, define entries, control pedestrian circulation, control vehicular traffic, and to screen undesirable views.
- A unified, fully developed landscape allows compatible buildings to look their best and can mitigate the negative visual impact of older, incompatible buildings.
- Carefully designed plantings create functional benefits by conserving water, increasing energy efficiency of buildings, improving air quality, reducing maintenance costs, and encouraging pedestrian circulation.
- Langley Air Force Base land management objectives are:
  - to improve the quality of life
  - to provide an aesthetically pleasing environment
  - to provide a harmonious image among the different base areas
  - to maintain effective control of dust, erosion and drainage
  - to reduce the potential for hazards to aircraft, facilities, and equipment
  - to support programs for the health, recreation and welfare of personnel.



7-1A *Good landscape design enhances the appearance of the courtyard.*



7-1B *Good landscape design enhances the appearance of the entry area.*

**Guidelines: Landscape Design SECTION 7.0****7.2 Site Categories****Improved Grounds**

- Areas immediately surrounding buildings that are used on a daily basis and approximately 20 feet on either side of primary roads are improved grounds.
- Primary roads are considered to be any road that has curb and gutter and/or carries the majority of through traffic in any particular area of a base. The perimeter drive around Langley Air Force Base is an example of a primary road that is not entirely curb and gutter, but is still considered a primary roadway.
- Daily use areas include cantonment areas, parade grounds, drill fields, athletic areas, golf courses, cemeteries, housing areas, and buffer areas around these spaces are considered improved grounds. For example, a minimum buffer of twenty feet is proposed around athletic and ball fields.

**Semi-Improved Grounds**

- This category includes areas that are not used on a daily basis and that can be maintained less frequently.
- Areas adjacent to runways, taxiways, aprons, golf course roughs, storage areas, antenna facilities, ammunition storage areas, etc. are semi-improved grounds.

**Unimproved Areas**

- These are areas not classified as improved or semi-improved.
- Minimal maintenance or plant care occurs.
- Typically, these areas are maintained by power mowing only or not mowed at all.
- Mowing is determined on the need for controlling bird behavior for airfield safety, or eliminating fire hazards.

*7-2A Improved Area – Primary Road**7-2B Semi-Improved Area – Airfield Area**7-2C Unimproved Area - Wetlands Wildlife Habitat*



**SECTION 7.0 Guidelines: Landscape Design****7.3 Regional Design****Existing Conditions**

- South Coastal Virginia has a temperate climate with hot, humid summers and mild winters.
- Langley AFB is located in the Coastal Plain and the soil is characterized by flat alluvial deposits of clay, silt, sand, and gravel.
- Climate is in the USDA Plant Hardiness Zone 7b.

**Landscape Materials**

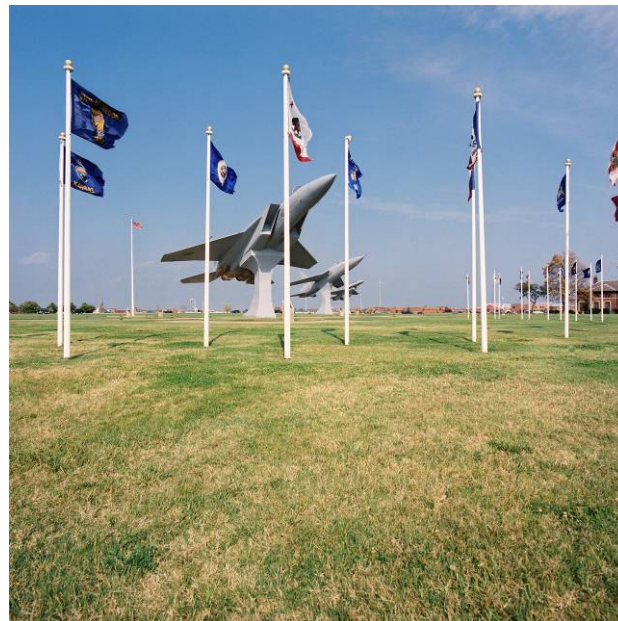
- Use adapted trees and shrubs locally recommended for urban or street use that can survive without irrigation after the first season or warranty maintenance period. (Preferred plant material list is attached as Appendix C.)
- Use native plants wherever possible. Where this is not feasible, use only fully naturalized plant species.
- Limit turf to significant open areas and places that are used for active or passive recreation.
- Use groundcover in lieu of turf in all other areas to the extent possible.
- Test soils prior to designing the planting plan. Identify deficient soils, areas of over-compaction, and soil pH. Modify or replace poor soil prior to planting.
- Follow the *USAF Xeriscape Design Guide*: Group plants according to water requirements and use mulches to conserve water.

**Energy Conservation**

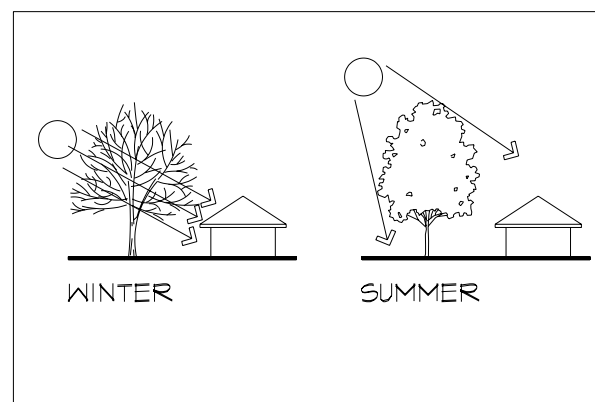
- Use deciduous trees on the south, east, and west sides to shade buildings during the summer but allow sun in the winter months (Figure 7-3B).
- Incorporate foundation plantings: Low evergreen plants on north facing walls mitigate winter heat loss.

**Irrigation System**

- If irrigation is required, design irrigation systems as recommended in the Air Force Irrigation Design Guide.



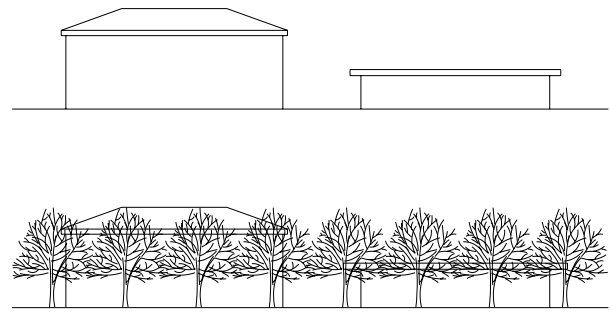
7-3A Limit turf to significant open areas and places that are used for recreation.



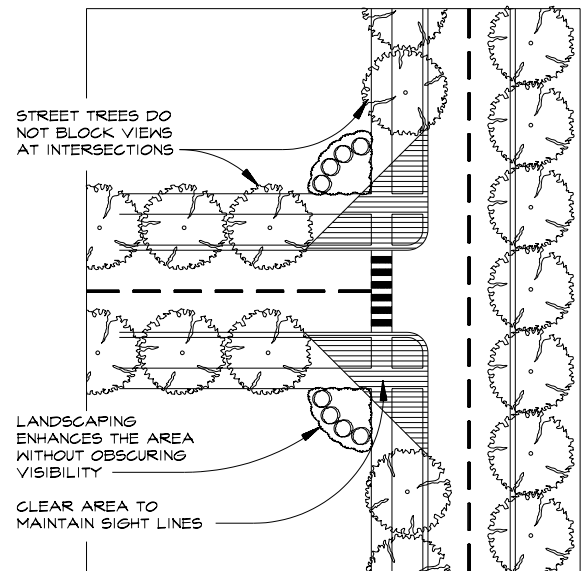
7-3B Planting for energy conservation.

**Guidelines: Landscape Design SECTION 7.0****7.4 Street Trees**

- Continue the practice of planting street trees to delineate roadways, reduce pavement temperature and provide shade on sidewalks.
- Consistent use of street trees will help to unify the base and mitigate the effects of non-compatible architecture (Figure 7-4A).
- Basewide, a variety of tree species should be used to avoid monoculture. A predominance of one tree type is more susceptible to pest and disease damage.
- Coordinate tree species selection with utility lines, signage, visual clearance requirements and other man-made constraints.
- Formal street tree planting design should use trees of the same species spaced at regular intervals.
- Provide adequate planting areas. Planting strips shall be a size appropriate to the species and class of trees to be planted. The trunk should be no closer than 5 feet to the sidewalk.
- Maintain clear sight lines at intersections (Figure 7-4B). Reference the Virginia Department of Transportation for regulations regarding plantings at intersections.



7-4A Use a single tree species to unify different building forms.



7-4B Sight lines at intersections.

**SECTION 7.0 Guidelines: Landscape Design****7.5 Parking Lots**

- Provide landscaping for approximately 10% of the area within all parking lots.
- Screen parking areas from view of major streets through the use of natural topography, earth berms, and vegetation (Figure 7-5A).
- Use a combination of trees and shrubs to provide both a visual screen and shade.
- Parking areas should be set back from streets. Setbacks a minimum of 20 feet wide will allow adequate space to incorporate planting for effective screening.
- Provide landscaped islands in parking areas to add shade, articulate vehicular circulation, and visually break up large expanses of paving (Figure 7-5B).
- Plantings must be low maintenance and suitable for harsh conditions present in parking areas.
- Limit use of wheel stops.

**7.6 Visual Screening**

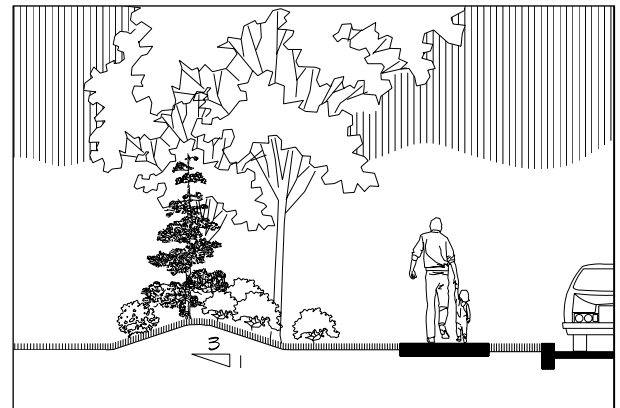
- Use berms to screen and restrict views. Do not use earth berms against building walls.
- Limit the slope to a maximum of one foot in 5 feet for a turf berm to be mowed
- Limit the slope to a maximum of one foot in 2 feet for a turf berm that will not be mowed.
- All applications for screening can be augmented by selective use of landscape materials. Plantings assist in blending a screen into the landscape.
- Use landscape materials to visually soften long fence lines.
- Use planting and/or earth berms to visually separate incompatible adjacencies (Figure 7-5C).
- Retain existing natural habitat as a buffer between housing and commercial or industrial uses.



7-5A Trees, shrubs, and a low berm screen parking from adjacent roadway.



7-5B Landscape islands define vehicular circulation routes and provide shade in parking areas.

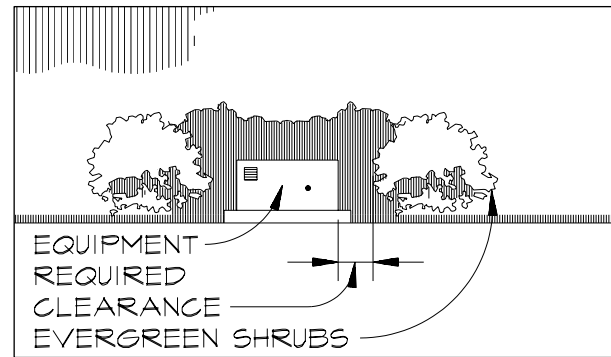


7-5C Example of an earth berm with plantings.



**Guidelines: Landscape Design SECTION 7.0****Equipment Screening**

- Use evergreen plants to screen equipment, storage areas, and other visually objectionable areas when a fence is not required.
- Maintain required airflow and maintenance clearances between plant materials and screened equipment (Figure 7-6A).
- Plantings around masonry enclosures or metal screens will integrate these elements with the surrounding site.



7-6A Landscaping to screen transformers and equipment.

**7.7 Foundation Planting**

- Use foundation plantings to visually integrate the building with the site.
- Landscape around the building perimeter to help direct pedestrian movement.
- To achieve a natural appearance, layer planting designs: place groundcovers in front, followed by small shrubs, with tall shrubs or small trees planted at the rear of the planting bed.



7-6B Foundation plantings visually integrate the building with the site.

**Maintenance**

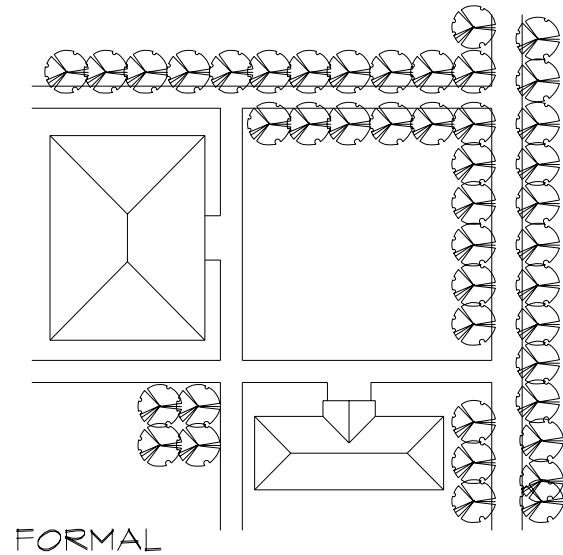
- Reduce maintenance requirements by using plant materials that maintain the desired height at maturity.
- Due to high maintenance requirements, sheared hedges and annual/perennial flowerbeds should be used sparingly.
- Proposed use of flowerbeds must be approved by the Base Civil Engineer.



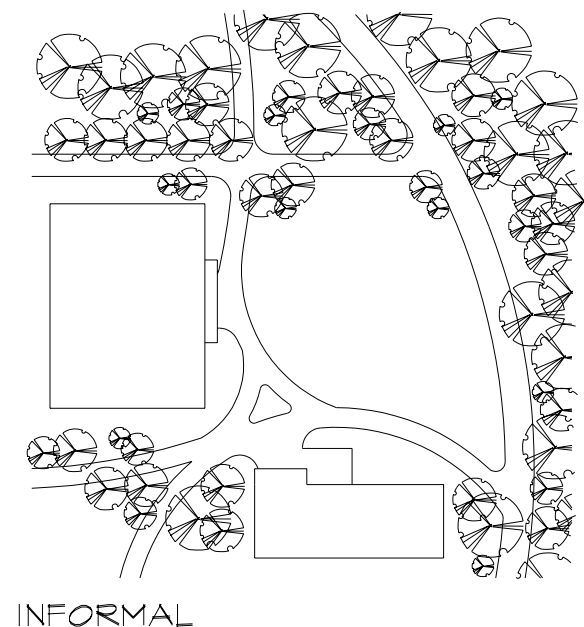
7-6C Use of flower beds must be approved by Base Civil Engineer.

**SECTION 7.0 Guidelines: Landscape Design****7.8 Courtyards and Entrances**

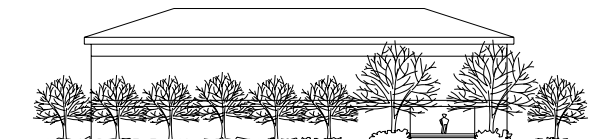
- Use mass plantings to define outdoor spaces (Figure 7-7A).
- Create landscape patterns that accentuate building entrances (Figure 7-7B).
- Design courtyard landscaping to give building users relief from summer heat.
- Use landscaping to enhance the entry sequence from the street or parking area to the building's main entrances.
- Tree grates should be used in lieu of planters.
- Where large planting boxes are used at courtyards, incorporate seating into the design.

**7.9 Planting Beds**

- Use thick mulch to control weeds and stabilize soil moisture. Mulch is appropriate around specimen trees, plants, and planting beds.
- Use shredded pine bark for shrub beds and course/chipped pine bark for tree beds. Do not use gravel for mulch.
- Provide protective vinyl or plastic edging for use as mowing edge.
- Planting beds should be sprayed with pre-emergent herbicide after ground preparation.
- Use mulching fabric, covered by thick mulch, to reduce weeds in planting beds.



7-7A Use plant materials to enclose outdoor spaces.



7-7B Landscaping to accentuate building entry.

**Guidelines: Landscape Design SECTION 7.0**

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**7.10 Plant Materials**

- Do not use plant material that drops large amounts of fruit or seedpods. Select deciduous trees that drop all their leaves early in the fall season rather than those that retain brown leaves most of the winter and continue to be a maintenance liability for many months; some trees to avoid are Sycamore, Beech, and some Oaks.
- Turf: Use turf only at recreation areas, courtyards or other places where it provides a benefit to personnel. Use ground covers to reduce maintenance, water and chemical requirements.
- Avoid use of many different species on a single project. Successful planting designs can be accomplished by using repetition with occasional contrast.
- Refer to the Landscape Management Plan (Appendix B) for plant species to avoid and would require intensive management or possibly future removal due to invasion by pest species or disease.
- The installation is encouraging the growth of cordgrass marshes on base as a more productive alternative to the invasive reed grass stands
- Select landscape materials with low maintenance requirements.
- Reduce the need for pruning by planting the right size plant for a space.
- Choose plants that do not need excessive amounts fertilizer, fungicides, and pesticides.
- A preferred plant species list is included as Appendix C.



**SECTION 8.0****Guidelines: Interior Design****8.1 General**

Facility interiors shall be designed in compliance with the *ACC Architectural and Interior Design Guidelines* (see Appendix A). The ACC guidelines should be used in conjunction with the following guidelines for special conditions at Langley.

- Designers of self-help projects shall consult with the Base Civil Engineer's office before beginning the design process.

**8.2 Floor Finishes****Carpet**

- Carpet borders may be used in command offices, conference rooms, and corridors.

**Entry and Lobby**

- At exterior entrance doors, incorporate recessed floor mats/floor grids where possible. Quarry tile and porcelain tile flooring should be designed for slip resistance.

**8.3 Wall Finishes**

- Limit wall coverings to command offices, conference rooms, corridors, and other high-use areas.

**8.4 Electrical Conduit**

- All electrical conduit must be concealed inside walls, except inside mechanical rooms.



8-1A Tile floor application in a lobby area.



8-1B Limit the use of wall coverings to command offices, conference rooms, corridors, and other high-use areas.

**Guidelines: Interior Design SECTION 8.0****8.5 Ceilings**

- Vary ceiling heights to create interest and reflect the use of the space. Public spaces often require higher ceilings than small offices. Incorporate soffits and indirect lighting in conference rooms and appropriate spaces.
- Two-foot by two-foot exposed grid suspended acoustical ceilings with reveal edge panels are the base standard. Variation in panel sizes and patterns may be used with approval of Base Civil Engineer.
- Where mechanical equipment occurs above suspended acoustical panel ceilings, specify removable grid sections to allow equipment removal.



8-2A Soffits and indirect lighting in a conference room.

**8.6 Doors and Windows**

- Housing: Door frames shall be wood.
- Non-housing: Door frames shall be hollow metal.
- Non-housing: Window sills shall be of a solid surfacing material such as Wilsonart Gibraltar.

**Window Treatment**

- Housing: Provide mini-blinds and curtain rods on all windows.
- Non-housing: Provide mini-blinds on all windows. Vertical blinds may be used at conference rooms.

**Finish Hardware**

- Housing: Finish hardware shall be solid brass with brushed finish.
- Non-housing: Finish hardware shall be satin brushed chromium plated or brushed stainless steel.



8-2B Use of varying ceiling heights in the library.

**SECTION 8.0 Guidelines: Interior Design****8.7 Base and Trim**

- Housing: Base and trim shall be painted wood.
- Non-Housing: Wall base shall be resilient vinyl. Wood may be used for wall base and trim in special command sections only.

**8.8 Furnishings****Systems Furniture (Pre-wired Workstations)**

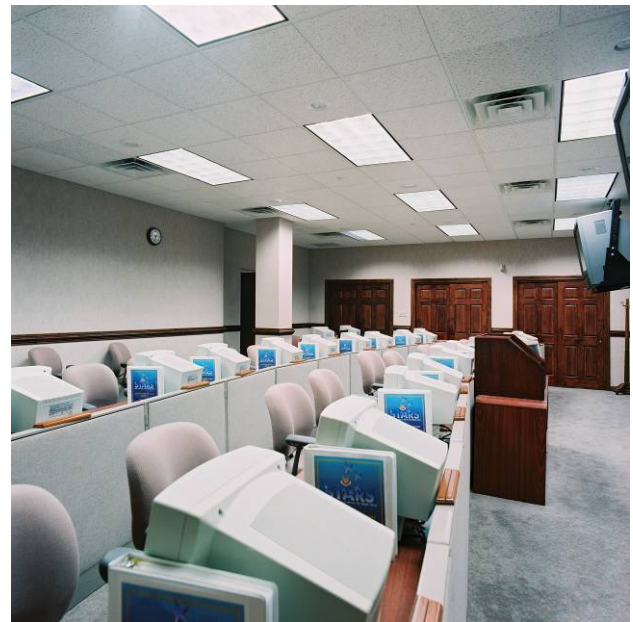
- Systems furniture workstation components are supported by pre-wired panels that have electrical power and communications outlets in the panel base. Panel assemblies must be hardwired to the building electrical system by a licensed electrician.
- All systems furniture in a building should be obtained from the same manufacturer. Use of proprietary specifications is an acceptable method of meeting this requirement.
- Use of power poles should be avoided.

**Modular Furniture**

- Modular furniture refers to self-supporting workstation components manufactured to common sizes or modules. The modular design allows components to be assembled in different combinations. Privacy panels may be used with modular furniture; however, the panels are not pre-wired with electrical outlets.
- No minimum square foot limits apply to use of modular furniture.



8-3A Base and trim in housing units should be white.



8-3B Systems furniture built to accommodate electronics.

**Guidelines: Interior Design SECTION 8.0**

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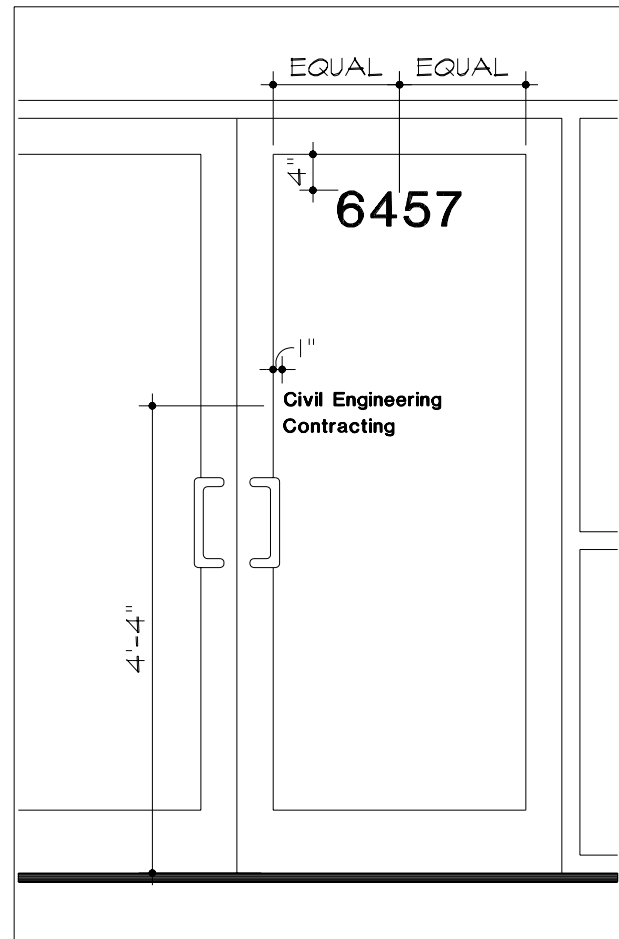


**SECTION 9.0****Guidelines: Signage****9.1 Exterior Signs****General**

- Exterior signs shall comply with the *ACC Instruction (ACCI) 32-1054* and *UFC 3-120-01 Air Force Sign Standard*.
- Langley Air Force Base has prepared a document, LAFB Supplement 1 to ACCI 32-1054 (provided as Appendix D), which modifies ACCI 32-1054 to suit the special needs of the base.
- Location and content of all exterior signs shall be subject to approval of the Base Civil Engineer. The number of signs will be held to a minimum.
- Lettering. Lettering for exterior base signs in the historic district of Langley AFB shall be upper case “Berling Bold” type style. Lettering of exterior base signs for the non-historic areas of Langley AFB shall be upper case, “Helvetica Medium” type style. The base design office shall approve the style of lettering for exterior base signs in the historic district.
- Organization names should normally be shortened to the minimum required to describe the function, for example, “Self-Help Store,” not “Civil Engineer Squadron Self-Help Store” or “Langley AFB Self-Help Store.”
- Signage for facilities that house the command section of an organization should include the number of the squadron preceding the organization, for example, “1<sup>st</sup> Fighter Squadron.” Abbreviations on signage should be avoided, but if necessary, AF approved abbreviations may be used.
- Several of the historic buildings have emblems and lettering incorporated into the design. These are significant to the character of the building and should be maintained. Buildings in the historic districts may imitate the style of the historic emblems when the design and character are approved by 1 CES.

**Guidelines: Signage SECTION 9.0****Building and Organization Identification Signs**

- Street address numbers shall be used to identify all facilities. Building numbers should be located below the street address as secondary identifiers in the format "B0000".
- Facilities with glass entry doors facing the street shall have white, pressure-sensitive address numbers applied to the entry door glass. Numbers will be four inches high, except in unusual cases where viewing distance from the street requires use of larger numbers. If larger numbers are needed, use the formula 1" high for every 25' of viewing distance as a guide to determine the height (Figure 9-2A).
- At pairs of doors, locate signage on right hand leaf. For buildings with more than one entrance, address numbers will only be displayed on the main entry door facing the street from which the building is assigned its address.
- Organization names will be displayed on the door below the address numbers using 1-1/2 inches high white, pressure-sensitive letters in upper and lower case. Commander and First Sergeant's names should not appear on the signage. The first line should be placed at 66 inches above the bottom of the door. A maximum of four lines of text should be used.
- For facilities that do not have entry doors visible from the street, the location of address numbers will be determined by the Base Civil Engineer. The preferred option is to mount individual dimensional numbers on an alternate location on the building, visible from the street. The numbers shall be non-ferrous material, dark bronze in color. Street address text should be sized proportional to viewing distance from the street. The building numbers text will be 2" in size, independent of viewing distance.



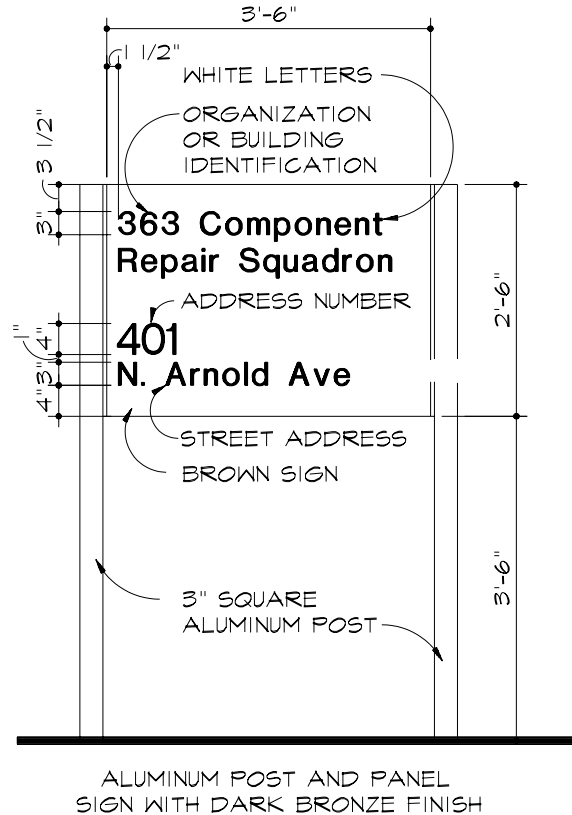
9-2A Building Identification Sign

**SECTION 9.0 Guidelines: Signage**

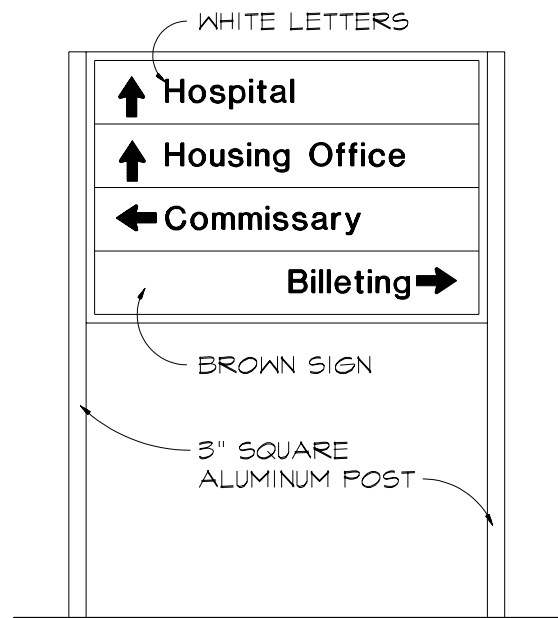
- If a freestanding sign is used, it shall be designed in accordance with *UFC 3-120-01 Air Force Sign Standard*. Freestanding signs shall have the following features:
  - White letters on brown background.
  - Aluminum post and panel design with 3-inch square posts.
  - Finish shall be fluoropolymer (e.g. Kynar 500) coating or equal.
- When the building address is posted in an alternate location, the organization name should still be displayed on the main entry door to indicate the public entrance to the building.
- Additional identification signage may be required at important buildings, such as headquarters, or on facilities with significant visitor use (Commissary, Billeting, Golf Clubhouse, etc.) These signs shall use individual dimensional letters mounted on the building. The letters shall be fabricated from dark bronze non-ferrous material, using uppercase Helvetica medium type style. Height of the letters shall be selected based on building size and viewing distance.
- AAFES/DeCA/Commercial signs shall comply with requirements of the *ACC Architectural and Interior Design Standards* and *ACCI 32-1054*.

**Directional Signs**

- Vehicular directional signs shall be designed in accordance with *UFC 3-120-01 Air Force Sign Standard*.
- Use Buff (Federal Standard 595B\_33690) reflective letters on Brown (Federal Standard 595B\_20117) background.
- Signs shall be aluminum post and panel design with 3-inch square posts. Finish to match building identification signage.



9-3A Freestanding Building Identification Sign



9-3B Directional Sign.

**Guidelines: Signage SECTION 9.0****Regulatory Signs**

- Traffic regulation signs shall be designed in accordance with the Manual of Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration.
- Posts for regulatory signs shall be galvanized steel or aluminum. Posts and sign backs shall have brown finish to match building identification and directional signage.
- Base warning signs shall comply with *UFC 3-120-01 Air Force Sign Standard*.
- Parking regulation signage shall comply with *UFC 3-120-01 Air Force Sign Standard*. Use curb markings where possible. Where post-mounted signs are required, posts shall be located to avoid vehicle damage. Handicapped accessible parking spaces shall be identified with a post mounted international symbol of accessibility in compliance with the Americans with Disabilities Act (ADA) and Uniform Federal Accessibility Standards (UFAS).
- Work area and personnel safety regulation signs shall comply with OSHA requirements and applicable Air Force regulations.

**Information and Motivational Signs**

- Placement and content of these signs shall be reviewed on an individual basis by the Base Civil Engineer, with an emphasis on maintaining a unified image for the base.



9-4A Directional Sign on Langley AFB.



9-4B Accessible Parking Sign.



**SECTION 9.0 Guidelines: Signage****9.2 Interior Signs****General**

- Signage should be designed as an integral component of the building interior design. Sign content, colors and locations must be consistent throughout a facility. To avoid a cluttered appearance, the number of signs should be reduced to the minimum required to guide visitors through the building.
- Interior signs shall comply with ADA and UFAS.
- A modular mounting rail system with changeable copy inserts should be used for interior signage.



9-5A Interior kiosk.

**Information Signs**

- Provide a building directory with changeable letter board in the entry lobby of large buildings and buildings frequently used by visitors.
- Bulletin boards should be mounted in office common areas and break rooms. Posting of notices and temporary information signs should be limited to bulletin boards.

**Identification Signs**

- Signs for the identification of rooms and permanent spaces should use plastic inserts with white lettering in Helvetica regular type style. Frame finish and background color of inserts should be coordinated with the interior design. Signs shall be mounted on the wall adjacent to the latch side of the door. Where this is not possible, as at pairs of doors, sign should be mounted on the nearest adjacent wall, outside the door swing area. Sign centerline should be 60 inches above the floor.
- Permanent room number signs should have one-inch high numbers raised 1/32 inch and Grade 2 Braille to comply with ADA and UFAS requirements.

**Guidelines: Signage SECTION 9.0**

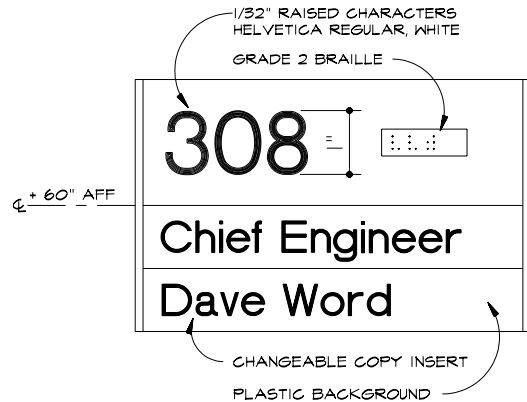
- Identification of signs for permanent public spaces such as restrooms and stairs should have one-inch high uppercase letters raised 1/32 inch and Grade 2 Braille to comply with ADA and UFAS requirements. The international symbol of accessibility should appear on signs that identify accessible facilities.
- Signage identifying office name or occupant title should be limited to those areas frequently used by visitors. These signs should be integrated with the room number into one large sign where possible (Figure 9-6A). Lettering should be upper and lower case Helvetica regular type style.
- Desk signs and signs identifying occupants in open office areas should be compatible with room number signage in color and type style. Signs should be designed to be adaptable to personnel changes by using changeable inserts for name/job title.

**Directional Signs**

- Signs used to direct visitors to important areas may be ceiling hung or wall mounted. Wall mounted signs should have frames and inserts to match room number signs, and should be mounted with centerline 60 inches above the floor. Ceiling hung signs should have 3-inch minimum height lettering. Text and arrows pointing up or left should be left justified. Text and arrows pointing right should be right justified. Direction signs should usually indicate room numbers, except for high priority destinations such as “Finance” or Pass Office.”

**Regulatory Signs**

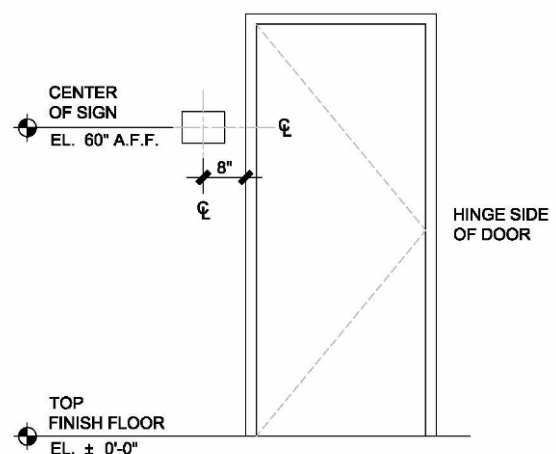
- Regulatory signage shall comply with OSHA, ADA/UFAS, Life Safety Code NFPA 101 and applicable Air Force regulations. Where applicable, provide signs that are compatible with room number signs by using similar frames, insert colors, and 60-inch mounting heights. (Figure 9-6C).



9-6A Interior signage



9-6B Interior signage on Langley AFB.



9-6C Typical Mounting Height for Signage

AIR COMBAT COMMAND CIVIL ENGINEER  
ARCHITECTURAL AND INTERIOR  
DESIGN STANDARDS

# **AIR COMBAT COMMAND CIVIL ENGINEER**

## **ARCHITECTURAL AND INTERIOR DESIGN STANDARDS**



**January 2002**

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## **COMMAND STANDARDS**

The Air Combat Command Architectural and Interior Design Standards provide guidance for all facilities on ACC installations, tenants on ACC bases, and ACC units on other major command (Majcom) installations except interior finishes in tenant facilities. It covers all project types including Military Construction (MILCON), Operations and Maintenance (O&M), Non-Appropriated Fund (NAF), P-341, and any base or tenant support by in-house, Self-Help, or Rapid Engineer Deployable Heavy Operational Repair Squadron Engineer (RED HORSE) resources. ACC bases must follow the ACC policy standards in local base architectural standards.

The ACC Architectural and Interior Design Standards must be followed in all these circumstances unless a waiver is obtained from ACC/CV. All waiver requests must be a signed letter by the Wing Commander of the requesting ACC base or the unit commander for units not on ACC bases. Submit the waiver request to ACC/CE, 129 Andrews Street, Suite 102, Langley AFB VA 23665. Submit the waiver request early in the design process, at least by the thirty-five percent design stage. Allow a minimum of 12 working days from the date of receipt for processing.

All AF 1391C forms submitted to ACC/CEP shall contain a section that identifies whether or not the project complies with the ACC Architectural and Interior Design Standards and the Base Architectural Standards. For more information contact ACC/CECT.

## **REGULATORY GUIDELINES**

The ACC Architectural and Interior Design Standards are not intended to provide comprehensive technical information generally known to professional architects, planners, engineers and interior designers. This guide does not provide all the information needed to design and execute a successful project, but should be used in conjunction with other documents and project specific criteria. All ACC projects must comply with regulatory guidelines such as the local building code, the National Electric Code, the Air Force Policy Directive for Installations and Facilities (AFPD 32-10), the Air Force Joint Manual for Installation Design (AFJMAN 32-1008), the Air Force Instruction for Design and Construction Standards and Execution of Facility Construction Projects (AFI 32-1023), the Air Force Instruction for Planning and Programming of Facility Construction Projects (AFI 32-1021), the Air Force Instruction for Planning and Programming Nonappropriated Fund Facility Construction Projects (AFI 32-1022), the Air Force Instruction for Planning and Programming Appropriated Funded Maintenance, Repair, and Construction Projects (AFI 32-1032), the Air Force Instruction for Standard Facility Requirements (AFI 32-1024), Air Force Pamphlet for Sign Standards (AFPAM 32-1097), the Air Force Instruction for Air Force Comprehensive Planning (AFI 32-7062), the Interim Department of Defense Antiterrorism/Force Protection Construction Standards, the Air Force Installation Force Protection Guide, the Air Combat Command Instruction Exterior Signs (ACCI 32-1054), the Uniform Federal Accessibility Standards, the Americans with Disabilities Act, the Military Handbook 1008C, NFPA 101, NFPA 1141 and the Uniform Building Code. This list is not meant to be all-inclusive. Architects, planners, engineers and designers should check with their Design Agent or government project manager for the latest guidelines.

## **ARCHITECTURAL DESIGN POLICY**

The special character of defense installations dictates “compatibility” over “personal style” or “architectural statements”. The limited size and function of ACC bases cannot accept the diverse opinions of the many design professionals without becoming cluttered and unsettled. In this context, “good design” is defined as design that contributes to the overall harmony of the base rather than design that attracts individual attention. Good examples of where ACC goals should lead are college campuses and corporate office parks. Because we do not want monotony, every building does not have to be the same, but some common architectural element or theme should tie all buildings together to create architectural compatibility. Buildings that hold special importance on the base such as wing headquarters and chapels should stand out as object buildings. Other buildings should function as background buildings. All buildings should be aesthetically attractive, convenient and logically laid out, technically sound, compatible with their environment and built with long-lasting materials and details that reduce life cycle costs. Responsible design will achieve this goal.

The Architectural Policy has a set of goals that guide the development of the policy.

- Site Conditions. Provide site improvements and building forms appropriate to any new, future or existing buildings. Facilities having similar or related functions should be located in the same vicinity. Do not let parking dominate. Encourage pedestrian access. Relate building forms to each other. Create small clusters of related buildings as opposed to spreading buildings out across the landscape.

- Environmental. Design facilities in ways to enhance environmental quality and minimize consumption of natural resources. Tightly cluster buildings that are related to each other creating walkable campuses. These clusters will reduce the amount of land use, utility costs to run utilities to large expanses of land, and vehicle costs to move from building to building. Consider participation in the Leadership in Energy and Environmental Design program.

- Layouts. Provide functional layouts that are logical and satisfy users’ needs both inside and outside of the facility as well as layouts that have the ability to accommodate other future users. Anticipate and plan for expansion.

- Low Maintenance. Use permanent low-maintenance exteriors that are compatible with ACC base standards and their natural and manmade environments. Use materials that do not require painting during their lifetime. Emphasize low life-cycle costs. Use indigenous landscaping that requires little or no irrigation and little or no maintenance.

- Aesthetics. Design buildings that are aesthetically attractive using materials that are indigenous to the local area or the function of the base. Follow the Base Architectural Standards. Keep in mind that all buildings do not have to be “object” buildings. Buildings such as chapels, dining halls, public buildings, etc. should stand out as object buildings, whereas other buildings should blend into the background emphasizing the object buildings. Facilities should foster a sense of pride among its occupants.

- Technology. Provide technically sound buildings at low costs. Take advantage of emerging technologies, but not at the expense of aesthetics or standards!

- Cost. Reduce life-cycle costs. Concentrate on low life-cycle costs as opposed to low initial costs. Our facilities should be designed, constructed and maintained to last decades. Reduce labor-intensive maintenance procedures.

- Approval. Obtain user approval of design concept layout prior to predesign conferences in order to prevent costly changes during final design, contracting and construction. This is normally done through a Customer Concept Document prior to preparation of programming documents.

## **SITE DESIGN**

The land in-between and around our buildings provides the fabric which holds our bases together. As such, these areas need to be as well thought out as our buildings. Well-designed outdoor spaces help create friendly, inviting, walkable communities. Site selection and design are important to achieve compatibility with the Base General Plan. The following guidelines for site location, site issues, pavements, landscaping, site amenities, site signage and infrastructure will help contribute to this compatibility. Include all applicable standards including force protection/anti-terrorism.

### **Location:**

Situate new buildings within compatible functional groups as determined by the base master plan.

- Complexes. Locate buildings supporting common functions such as civil engineering, administrative, or flying functions in complexes in order to share a common infrastructure of roads, parking, utilities and security. These tight clusters should read as one idea with similar details and materials that link them aesthetically as well as functionally. Provide enough space around a complex for expansion. Assume ten expansion whenever other supporting data is not available.

- Environmental. Design facilities in ways to enhance environmental quality and minimize consumption of natural resources. Clustered buildings reduce the amount of land use, utility costs to run utilities to large expanses of land, and vehicle costs to move from building to building.

- Traffic. When existing traffic patterns are changed by new construction proposals, provide adequate traffic alternatives to coincide with the construction of the new project. Locate buildings so that you can walk between buildings in a functional group. Only encourage driving when walking cannot be accommodated. Design parking lots so traffic can move between adjacent parking lots. Avoid the commercial strip parking lot system where lots are designed so vehicles cannot move between lots.



- Noise. Consider noise levels and attenuation requirements when locating facilities. Do not locate facilities in incompatible noise zones unless no other options are available.

### **Site:**

Once the site has been selected, address every aspect of site planning early in the process, including building siting, relationship of interior spaces to the site, pavement, landscaping, pedestrian access, signage, service equipment, infrastructure, and other barriers. Design facilities considering both the inside functional requirements of the buildings and the influence of the site. Design the entire site. Include all applicable standards including force protection/anti-terrorism.

- Site influence. Do not use sites that force building functions into basements, third floors, or uneconomical shapes such as curves, diagonals, or long rectangles.

- Open area. Use sites that permit open landscape space around buildings to separate the building from required pavement. Prevent an overcrowded appearance. Do not allow pavements to come directly up to facilities except for especially selected, purely industrial uses.

- Existing site contours. After positive drainage away from buildings is developed, use existing or natural grades and contours to avoid excessive cut and fill operations.

- Setbacks. Sites need to allow minimum setbacks from other structures such as buildings, roads, and parking. Minimum setbacks are 25' for the front and rear, and 30' for the side. Keep setbacks consistent with buildings and other structures in the area.

- Environmental. Site buildings in accordance with appropriate laws and directives regarding wetlands, flood plains, protected species habitats, and archeological sites.

- Screening. Screen utility equipment, dumpsters, and storage areas. Use walls and mature landscaping or berms. Do not use chain-link fence. Exterior recycling bins should be treated and screened as trash dumpsters.

### **Pavements:**

Pavements include streets, parking lots, sidewalks, and airfield pavement.

- Parking. Use size, location, and screening to prevent parking from becoming a dominant feature. Use consistent angles and stall sizes in all parking areas. Use drop-off areas at high-use facilities to decrease close-in parking. Use raised parking islands to break up parking areas except in areas with excess snow. (Contact ACC/CEC for a list of excess snow areas). Curb all parking lots and avoid using wheel stops/bumper blocks.

- Buildings and Parking Lots. Do not locate parking directly in front of buildings or entrances. Do not locate parking between the main viewing street and buildings. Locate parking behind buildings. When a building is located between a street and a parking lot the building appearance

is improved and the parking is screened with minimum cost. Consider building shape and relationship to other buildings to provide as much screening as possible. Ensure the principle or main view of the building presents a pleasing and uncluttered appearance. The parking arrangement is a major factor in providing an orderly appearance.

- *Parking Lot Size.* Use separate smaller parking lots of 50 cars or less rather than one large lot. Where large parking lots exist, landscape approximately ten percent of the area within the lot except in excess snow areas. (Contact ACC/CEC for a list of excess snow areas)..

- *Walking distance.* Design parking lots to limit walking distance. Use a maximum of 200 feet for most buildings; for transient and unaccompanied housing limit luggage carrying and walking distance to 100 feet.

- *Paving.* Use economical asphalt paving for most vehicle parking areas, but avoid asphalt sidewalks and curbs. As a minimum, use concrete for sidewalks and curbs. Consider special unit pavers for courtyards, plazas, entrances and other high-profile sites. Provide a landscape buffer between all buildings and paved areas.

- *Streets.* Avoid utility or other cuts in pavement. Whenever possible use tunneling technologies to go under pavement with conduits or piping. Streets should intersect at right angles and offset intersections should be avoided.

- *Curbing.* Curb all parking, access roads and streets (except remote/isolated). All primary streets and all parking lots should be paved with integral concrete curbs and gutters. Painted curbs are prohibited because they are very difficult to maintain. Provide mower ramps for access to grass areas.

- *Walkways.* Use concrete walkways at least 48 inches wide to link facilities and promote pedestrian use. Illuminate walkways used heavily at night. Provide walkways on at least one side of every street and between all facilities. Avoid placing utility poles or signs too close to sidewalks. Locate walkways judiciously and in accordance with the Manual on Uniform Traffic Control Devices. Contact ACC/CEO for further guidance.

- *Handicapped Access.* Ensure handicapped access is provided at intersections, crosswalks and wherever UFAS and ADA require them to be.

- *Drainage.* Design paved areas to minimize drainage. Drain into natural water courses, detention, and retention ponds.

## **Landscape:**

The use of appropriate trees and other landscape plantings provides a positive first impression, promotes energy efficiency, inhibits erosion, reduces noises, and enhances safety by helping to control blowing/drifted snow. Landscape planting also supports national policy aimed at enhancing air quality. All landscape plantings should comply with the base land management plan. Develop functional rather than purely visual landscapes. Plan to reduce maintenance.

Provide a landscaped space uncluttered by vehicles in front, at the entrance, and between the main viewing street and buildings.

- *Plant material.* Consult the Base Architectural Standards for an appropriate landscaping material list. Use indigenous, low maintenance, adapted trees and shrubs locally recommended for urban or street use that can survive without irrigation after the first season (one year) warranty maintenance period. Do not use plant material that drops large amounts of fruit or seedpods. Select deciduous trees that drop all their leaves early in the fall season rather than those that retain brown leaves most of the winter and continue to be a maintenance problem for many months. Some trees to avoid are Sycamore, Beech, and some Oaks. Place mulch bed around all trees and shrubs. Consider fabric barriers that contain an effective pre-emergent herbicide that will provide protection for many years.

- *Sustainable Landscaping.* Landscaping practices should incorporate sound design planning while minimizing the requirement for fertilizers and pesticides. Use water efficient practices such as mulches, efficient irrigation systems (drip irrigation), and reclaimed water. Consider using boulders with plants, gravel blankets for grass, and pebbles for ground cover. Soften arid landscaping with varied contours and drought-tolerant plantings.

- *Preservation.* Preserve existing landscape where possible. Use consolidated development areas to help preserve the existing landscape. Avoid overplanting and allow for natural growth and form of plants. Limit turf and keep it free of obstructions which require trimming. Define planting areas with walkways, edging and concrete curbs.

- *Mowing strips.* Provide planting beds with wide mowing strips. Mowing strips should eliminate hand trimming and edging caused by turf creeping into bedding plants.

- *Surface Runoff.* Use trees, shrubs, grass and landscaping to reduce storm water runoff. Terrace steep slopes.

- *Berms.* Use berms to screen and restrict views. Limit berm slope to one foot in 10 feet. Do not use earth berms against building walls.

- *Function.* Use landscape to reduce energy cost, shade to prevent heat and glare, and windbreaks to lessen air infiltration. Use landscape to screen unsightly views, control pedestrian circulation, define entries, and accenuate outdoor amenities.

## **Site Components:**

Site components include site furniture, bicycle racks, trash receptacles, etc. Site components and the spaces in between buildings should be as carefully planned as the spaces within buildings. These spaces provide a cost effective way to provide pleasurable spaces. Encourage attention to detail concerning each of these site components. Work to reduce visual clutter, unnecessary signs, receptacles, etc. Include all applicable standards including force protection/anti-terrorism.

- *Site Furniture.* Site furniture is defined as furniture or other accessories provided in outdoor areas for the comfort or convenience of personnel. Examples are benches, litter receptacles, ash

cans, picnic tables, and bicycle racks. The design of site furnishings should respond to the local climate and cultural influences. Bases have established an overall plan that complements the installation architecture and environment. Use these for site furniture selection.

- *Color.* Use site furnishings to complement exterior color schemes. Limit colorful accents to high-profile sites. Ban the use of red ash cans and yellow pipe bollards.
- *Materials.* Use durable materials which are appropriate for the architectural context and the environment, such as factory finished metals, precast concrete, or quality wood. In hot climates, be careful of metal finishes that may burn anyone who might touch the object.
- *Outdoor Seating.* Provide comfortable benches or seat walls near building entrances and in courtyards. Tables should be limited to informal gathering places such as picnic or dining areas.
- *Receptacles.* Place litter receptacles and planters on paved sites where they are clear of circulation. All litter receptacles require attached lids. Ash receptacles must match outdoor furniture.
- *Bollards.* Bollards shall be set into paving or placed in sleeves to allow access. Use bollards to enhance pedestrian protection and provide vehicle control.
- *Bicycle Racks.* Bicycle racks should be located near entrances in secure, visible areas. Racks must be on concrete, brick or block pads. Use simple, attractive racks.
- *Flag Poles.* Locate flag poles in accordance with AFR 900-3. Morale flagpoles are not allowed in accordance with AFI 84-105.
- *Other Assorted Items.* Consider accessories such as newspaper vending machines, smoking receptacles, planters, refuse containers, and other equipment in design plans. Neutralize the visual impact of these items by developing a basewide standard, as well as painting, concealment, or removal. Locate these items in convenient yet discrete locations.

## **Site Signage:**

Site signage must provide clear, consistent, and necessary direction or information. Correctly designed and controlled signs can be a positive aspect of the installation's overall professional image. Follow ACCI 32-1054, Sign Standards Pamphlet. The following are excerpts from ACCI 32-1054 and are not all inclusive. National Highway Traffic Safety Administration signs must be used for all regulatory and warning traffic signs.

- *Visual Clutter.* Reduce visual clutter by eliminating super-graphics, poorly designed signs and outdated information. Taping temporary signs on doors, walls, or windows is prohibited. Condense and consolidate information to minimize the number of signs. Standardize the height of all signs by type. Use sign systems that will accommodate changes.

- *Color*. All exterior signs will be consistent throughout each installation. Langley brown (Federal spec 21000) background is the ACC standard. Poles and back of signs should be painted or factory finished to match.
- *Street Signs*. Include the Command shield on all street signs. Color and lettering should be consistent with other signs on the installation. Ensure there is a street name sign for each street at intersections.
- *Directional Signs*. Install directional signs only where needed to guide visitors and new base personnel. Normally, only four entries should be displayed on a sign.
- *Special Signs*. Limit unique signing to high-visibility locations where highlights are required to support the architectural theme. Avoid plastic letters and marquee and warning signs on the outside of utility or equipment room doors unless required by code.
- *Parking Signs*. Reduce the number of parking signs by strictly limiting reserved parking, including temporary reserved parking. Standardize reserved parking designations by installation.
- *Temporary Sign Standards*. Develop a simple base standard for temporary signs such as a painted brown 4"x4" column with a wood base and a brown sign with white lettering .

## **Infrastructure:**

Components of the installation infrastructure such as street and area lighting and fuel and water storage tanks must be considered when developing facilities. Emphasis should be placed on reducing visual impact by proper siting, painting, screening, or concealment. Utilities should be underground whenever possible. Allow sufficient capacity for future growth. Ensure all applicable standards are followed including force protection/anti terrorism.

- *Color*. New equipment should have a factory-applied color appropriate to the installation standards. Paint existing equipment to match. Avoid galvanized or green finishes.
- *Screening*. Use walls and landscaping to screen all utility equipment but maintain required access and clear zones. Avoid the use of metal or wood fencing. Do not use chain-link fencing except for perimeter fencing or high security locations. See the Base Architectural Standards for screening materials appropriate at each base.
- *Special Purpose Lights*. Use lighted bollards along high-use walkways, inset stair and wall lights for plazas and high-use walkways.
- *Street and Parking Lights*. Rectangular shaped luminaries are preferred for high-profile locations and dark colored cobra heads for outlying sites. Comply with the Base Architectural Standards. Use consistent lamp types. Metal halides lamps are preferred for most areas, but sodium lamps may be used where necessary. Avoid bright finishes and trendy mountings. Avoid use of low-pressure sodium lamps.

- Fuel and Water Storage Tanks. ACC prefers well-screened, appropriately site above ground tanks. Ideally this means that each tank is located out of view from any major road, main building entrance or significant outdoor space and well screened with a screen wall that matches its parent facility or if there is no parent facility follow the Base Architectural Standards. If this is not possible then use a vaulted tank and size the manholes adequately for maintenance and inspection or use a UST compliant with ACC MAN 32-7051. All UST locations and screening must be approved by ACC/CEC. Submit supporting documents (plans, site plan, elevations, tank details) to ACC/CEC. On above ground storage tanks avoid multiple colors, super-graphics, logos, and glossy finishes. Colors should be consistent with the installation Base Architectural Standards. Elevated storage tanks may be used to display the AF shield only on the base standard tan or beige background, appropriately sized and proportioned. Send in a site plan for each tank for ACC/CEC approval during the planning phase of the project.

- Security. Use quartz lights in secure areas and controlled access points where an instant-on feature is required. Do not use lighting to enhance architectural features.

- Fire Protection. All facilities must be designed and constructed in accordance with Mil Handbook 1008B and other ETLs available through ACC/CEC.

- Sewer. When siting multiple facilities, gravity flow sewers are desired instead of individual pumping stations at each facility.

- Efficient Use of Utilities. New facilities must be designed and constructed to minimize life cycle costs or exceed energy performance standards. Active and passive solar will be considered in new designs. Water conservation initiatives are encouraged. Many varieties of fluorescent and high-intensity discharge lighting produce quality lighting.

## **FACILITY DESIGN**

Our buildings and the areas around them provide not only our places of work and relaxation but also reflect our sense of pride in ourselves. As such, each building and its site should be aesthetically attractive, convenient for its users, technically sound, compatible with its environment, and built with long-lasting materials and details. Refer to the installation Base Architectural Standards for exterior base standards. Base standards establish an architectural theme in keeping with the existing historical styles, local climate, and construction standards. Provide economical construction without compromising a high quality, architecturally pleasing, and professional military appearance. Ensure all standards are followed including force protection/anti-terrorism.

Exterior treatment requires careful management to achieve the desired overall compatibility. Each base has to define a context and direction based on existing built and natural environment. Ensure that the exterior details respond to the building's use, location and importance on base. Use of the following guidelines will achieve the desired ACC standard.

**Form:**

Use simple plans and building forms as well as conventional sloping roofs. Eave heights may vary as required by interior functional relationships, but do not use more than one pitch angle on a building. Do not combine two kinds of roof such as flat and sloping roofs on the same building unless it is clearly justified by the influence of adjacent architecture, building function or layout. Minimize corners, offsets and curves on horizontal and vertical surfaces. Use only as clearly justified by the adjacent architecture, building function, or layout.

- *New versus old.* Imitate and improve on existing base building forms to provide harmony between new and old. When new sloping roofed buildings are sited among existing flat profiled buildings, steps must be taken to develop some secondary flat forms to relate the new to the old.

- *Height.* Except for dormitories, which are limited to three stories, limit buildings to two stories above ground. Do not use basements for occupied spaces.

- *Main Entrance.* Main entrances should face a major street. Emphasize the main entrance of all facilities using a combination of architectural treatments and building signage.

- *Mechanical.* Do not let mechanical systems become form-givers. Locate mechanical units to the rear or side of buildings. Design these features to blend in and to integrate with the building architecture in such a way that they are not prominent or detectable. Match materials for mechanical enclosures to the building they serve; i.e., masonry with masonry. Do not use roof-mounted equipment. If no other alternative is available waiver requests for rooftop mechanical equipment should be submitted to ACC/CEC. If required, match the equipment enclosure to the roof or wall material, as much as possible. Equipment wells are also acceptable. As a minimum, screen any equipment at ground level with landscape. In arid climates architectural screens are required. When screening mechanical equipment, ensure adequate clearance, as recommended by the equipment manufacturer, is provided to allow for proper air circulation and maintenance.

**Walls:**

Minimize use of curves, cants or angles other than 90-degree corners. Use only as clearly justified by the adjacent architecture, building function or layout.

- *Material.* On exterior walls use low maintenance durable materials that are integrally colored and textured such as brick, split-face Concrete Masonry Units (CMU), split ribbed CMU, prominently exposed aggregate on precast concrete or other substrates, and integrally colored concrete that is textured by use of form liners. Brushed, honed or sandblasted concrete is not acceptable. Do not use materials that require painting on new buildings. Avoid the use of materials that require painting on renovation projects. Use of bricks, blocks, or grout containing fly ash or other byproducts is encouraged. Use concrete containing fly ash or other recycled materials. Autoclaved cellular cement should be used where appropriate. On interior walls the use of exposed or painted CMU is not allowed except in gymnasiums or industrial uses. Decorative split-face CMU, ribbed CMU, or similarly integrally colored, textured masonry materials may be used as interior finishes in building entries with a waiver from ACC/CEC.

- *Metal*. Metal walls are only acceptable for extremely large buildings such as aircraft hangars and temporary buildings. See the metal building section of this document. Exposed metal stairs are not acceptable in any renovation or new facility.

- *Painting*. Do not paint new buildings and do not use materials that are typically restored by painting such as stucco, exterior insulation finish systems, metal fascia, and various kinds of siding on renovations. Secondary doors may be painted as described in the next paragraph. On metal buildings, select a factory prefinished material. See the Base Architectural Standards for this selection.

- *Anodized Aluminum*. Color anodized aluminum in neutral colors (suggest dark to light bronze) is recommended for exterior metals normally associated with walls such as fascia, gutters, downspouts, windows, and building entrances. Fire exit doors and other secondary doors and frames may be painted for economy. When painting secondary doors and fire exits, they should be painted to match the primary color anodized entrances or painted to match adjacent walls; this is a designer option. The objective is to produce a simple appearance which is uncluttered by many colored shapes.

## **Doors and Windows:**

Aluminum anodized, factory finished door and window frames are preferred for most locations. Avoid use of mirrored glazing. Operable windows and tinted, energy-efficient glazing are encouraged. Where appropriate, install window screens to take advantage of natural ventilation. Provide window screens where windows are operable and designed for ventilation. Windows, which operate primarily to allow cleaning, do not need screens. Provide screens for Military Family Housing (MFH) and Unaccompanied Enlisted Personnel Housing (UEPH).

## **Roofs:**

Flat roofs and interior gutters are prohibited. Use sloped roofs equal to or greater than 3:12. Use proven, cost-effective roof systems with high durability and weather resistance such as factory-finished standing-seam metal or shingle roof. Ensure colors are compatible with ACC and base standards. These low-maintenance alternatives are required because of the poor maintenance history of low slope (less than 3:12) single and multi-ply roofs and systems as well as built-up roofs. Generally use a hip or gabled roof. Do not combine roofing materials such as metal and shingles on one roof. Make all of the building parts compatible with each other. Overhangs for weather protection and shade are desirable. Do not locate mechanical equipment on the roof. Where unavoidable, make sure rooftop units are screened. Roof-top mechanical units require a waiver from ACC/CEC. Roofing made from recycled materials is encouraged.

- *Alternatives*. Do not use low slope roofing if 3:12 or steeper pitch if feasible. Building form and size (extremely large buildings such as supply facilities, main base exchanges, or commissaries) may occasionally require lower slopes and other materials. Roof designs lower than 3:12 require a waiver from ACC/CEC except commissaries and main base exchanges. If designing a low slope roof, slopes as low as 1:12 are generally accepted for structural standing seam metal (consult with manufacturers for particulars). When a single or multi-ply roof is used,



slope the roof at 1/4:12 minimum. The slope is to be accomplished with structural members for new built up roofs, not by tapering the insulation.

- Drainage. Provide continuous roof slope to the perimeter of the building. Do not design interior valleys or depressions that will form ponds if a roof drain becomes obstructed. Ensure overflow scuppers are provided in accordance with applicable codes for parapets. If interior drainage can not be avoided, submit to ACC/CEC for approval.

- Skylights and clerestories. These features may be used where strong functional and economic justification dictates. Fully document economic justification and submit with proposed design to include life-cycle cost of special ballast and control devices to ACC/CEC for approval. Be sure to consider heat load and occupant comfort as part of the proposed design. General area lighting for warehouses is not considered strong enough functional justification to compensate for the generally high maintenance associated with large numbers of skylights on a low slope roof.

- Metal fascia. Do not use wide metal fascias with low slope roofed buildings. If a band is desired around the top of a building, provide it with masonry detailing such as projections, soldier course, or stack bond. Masonry detailing provides a more durable maintenance free fascia that does not require painting.

### **Additions:**

When building additions are proposed, careful coordination is required to determine if the addition should match the old building or if the old building should be changed and brought up to ACC standards at the same time as the addition.

- Small addition. When additions are less than 25% of the existing building's floor area, design additions to match the original construction.

- Large additions. When additions exceed 25% of the original building area, the addition and the original construction are required to comply with ACC standards. For example, a flat-roofed building of 10,000 square feet needs an addition of 3,000 square feet. In this example 3,000 is more than 25%. The additions would have a sloped roof, and the original building would be designed to have a sloped roof. If the original building were plain CMU, then a new exterior wall finish of textured CMU would be considered either in the form of a complete veneer or as a minimum, use textured CMU at important visual points such as entrances, planters, sign, corner protection, etc.

- Compatibility. In either case (large or small), when additions are complete, they should be architecturally compatible rather than obvious add-ons.

- Fire Sprinklers. Designers of additions need to evaluate the need for sprinkler protection for both the new and existing structure.

## **Metal Buildings:**

Metal buildings may be used for only large structures such as hangars or temporary facilities. When large buildings are metal a masonry base proportionate to the height of the building is required. The base must be an integrally colored, textured masonry base for durability. Temporary buildings must be removed within one year. All temporary buildings and large buildings except hangars require a waiver from ACC/CEC. Specialized facilities such as water towers and fuel tanks may be metal.

- Location. Use metal buildings where they are compatible with adjacent structures. Do not use temporary metal buildings in highly visible locations. Temporary metal buildings used anywhere should be well screened with walls or vegetation.

- Finish. Use factory applied finishes with more than 15-year warranties.

- Submit site justification. At the programming stage, submit siting criteria and waiver request to ACC/CEC. Indicate adjacent building construction. If the building is isolated, describe how visible it is from major, minor, or service roads. State reason for selection of metal over masonry in addition to cost consideration.

- Protective masonry. Provide protection on the exterior of buildings where impact to metal panels is probable. For example, integrally colored and textured masonry should be used at entrances, at corners, exterior wainscot to four feet high where vehicles are parked next to buildings, around forklift operations, and at loading docks.

## **Colors:**

Each installation is required to have an exterior color standard. The Command standard is to use neutral colors such as bronze, tan or beige or colors that occur naturally in traditional building materials as the field colors with complementary trim colors which are compatible with regional color motifs. Use neutral anodized colors such as brown tone or gray tone neutral. Judgement has to be exercised in selection of colors for isolated miscellaneous features such as exit doors, downspouts, etc. In some cases, a building benefits from having isolated features colored to match adjacent light-colored walls. This is very important on older buildings with many windows and doors. Coloring trim a contrasting color can produce a cluttered appearance.

- Wall materials. Select neutral colors such as beiges and browns, as large wall surfaces should not attract attention.

- Exterior metals. Use neutral anodized colors such as bronze. When aluminum, hollow metal, and wood are mixed on one building, hollow metal and wood may be painted to match the aluminum color or adjacent walls. In any case, do not use a third color that does not match the bronze metals. Use one trim color to the greatest extent possible.

- New work. Do not paint new masonry; instead use integrally colored, textured masonry materials.

- Color use. Usually two colors on a building produce the best appearance - one wall color and one trim color. Do not use more than three colors - one wall color and two trim or accent colors such as exposed aggregate fascia, columns, beams, etc.

### **Utility and Dumpster Enclosures:**

Provide an enclosed yard to conceal miscellaneous support items such as generators, transformers, trash, lawn equipment, flammable storage, HVAC, meters, and aboveground tanks.

- Enclosures. Match enclosing walls to the building wall material. Split faced CMU is a good durable material. When this is not possible, metal slats and planting may be used. In some cases, plant material by itself may be used to conceal the service area, but it must functionally conceal the service area at the time of planting. All enclosures need to be at least six feet tall. If the items being concealed are taller than six feet then the enclosure should be as tall as the tallest item in the enclosures plus six inches. The use of open panel block is permitted when enclosing electrical substations, transformers, or switches for proper heat dissipation.

- Gates. If possible locate trash and mechanical enclosures so the access to the enclosure is not visible from major streets or major building entries. If this is not possible, provide gates for trash enclosures. Also provide gates for enclosures where accessibility needs to be limited.

- Subdivide. Organize and layout the service yards by responsibility. For instance, HVAC equipment should not be in the trash enclosure. Many of the functions may require separation and separate access such as tools, lawn mowers, fuel, etc.

- Pavement. Provide vehicular access and surfacing such as pavement, grass pavers, or gravel to reduce maintenance. Use concrete curbs or edging.

- Service Areas. Integrate service areas with the building design and match adjacent materials.

### **K-SPAN:**

K-SPAN use and application are more suited to forward operating locations of CENTCOM and SOUTHCOM, or during contingency operations. In all cases, K-SPAN facilities to be located on ACC bases require HQ ACC/CE siting approval prior to purchase, delivery, or start of work. Treat inflatable buildings the same.

- Use. Limit K-SPAN to storage applications outside the main area of ACC bases such as weapon storage areas, if approved by ACC/CV.

- Structural. Provide additional reinforcing and structural analysis when either design wind load or design live load exceeds allowable values for a K-SPAN structure of given width and height. Consider K-SPAN structures with a factory finished metal.

- Site Justification. Submit site justification with programming documents. Provide enough information about the intended site to satisfy HQ ACC/CE that the K-SPAN buildings will be

compatible with their surroundings. Indicate what is in the site vicinity and if the buildings are visible from roads or populated areas.

### **Solar Application:**

Integrate solar components with roof or wall forms. Give preference to passive solar applications over active solar applications. Do not let solar components clutter or break the normal building form line. Example: vertical collectors should look like glass walls and roof collectors should match the roof slope. Exceptions: when collectors do not look like walls or match roof slopes, screen them from view with materials that coordinate with the building material.

### **Facility Signs:**

Provide signs that comply with base architectural compatibility and ACCI 32-1054, Exterior Signs. No organizational emblems, logos, or direct-paint applications are permitted. Identification of key personnel such as commanders is also not permitted. Standardize building address sign size and placement on each installation. One unit identification sign is permitted for each facility.

- Moving Signs. Do not use moving or revolving signs on ACC bases.

- Monument. Use of monument signs is limited to headquarters buildings (MAJCOM, NAF, wing and group commanders). See ACCI 32-1054 for guidance.

- Lettering Size. For signs other than those covered by ACCI 32-1054, size lettering according to the functional viewing distance. Keep sign size to a minimum. The rule to follow for readability is one inch of letter height for each 25 feet of view distance. Example: If a sign is intended to be read from a passing car using a road 100 feet away, the largest sign lettering would be four inches (100 divided by 25 equal 4). Do not oversize.

- AAFES/DeCA/Commercial Signs. Logo and lettering supplied by AAFES/DeCA/or the parent organization are required to be the AF and ACC standard. Contact ACC/CECT for a copy of the standard sign.

- Lighted Signs. Internally lighted signs create a commercial impression that is not compatible with AF and ACC standards. When night visibility is functionally required, use external flood or spot lights that illuminate both the sign and adjacent landscape or building. Illumination of the sign with its surroundings makes a better impression and improves orientation.

- Lettering. All lettering on all base signs should be of the same style, upper and lower case Helvetica medium type style.

### **Exterior Graphics, Striping and Banding:**

- Super Graphics. Painted stripes, letters, and supergraphics are prohibited and not compatible with current AF and ACC standards.

**Force Protection/Anti-Terrorism:**

Coordinate and integrate force protection/anti-terrorism elements such as walls, blast protection and fences with base and building architecture as well as good architectural practices. For instance, during site planning cluster buildings that are functionally compatible with strong boundaries and move parking away from the cluster. Use distance in a positive way. During facility site design, use landscaping, bollards, planters, and other site amenities as barriers. Provide adequate lighting. Place utilities underground. In facility design, elevate the first floor, construct blast protection by surfacing it with the same materials as the building that it is protecting, and minimize signage. Good force protection/anti-terrorism planning and design is compatible with good planning and architectural practices.

**INTERIOR DESIGN POLICY**

Design standards have been developed by the professional design staff at Air Combat Command Civil Engineering (ACC/CECT) to provide for the best possible coordination of interior finishes and furnishings for long-lasting maintainable interiors.

These standards are developed around an understanding of the elements and principles of design and how the industry operates, not around personal likes and dislikes.

Each year the Color Association of the United States (CAUS) develops a color palette for the succeeding year. This palette changes gradually each year and is the guide by which manufacturers determine the colorways in which they will produce their products. Whether it be fashion or automobiles, refrigerators or ceramic tile, these color palettes influence manufacturers. The images of the pink and black tile bathrooms of the 50's, the avocado green or harvest gold kitchen appliances and laminate countertops of the late 60's and early 70's, and the mauve and teal color schemes of the 80's is why it is a mistake to use faddish colors in permanent finishes. All in-vogue or trendy colors become dated once wallcovering, carpet or other manufacturers change their color palette.

The Air Combat Command standards ensure materials purchased and installed in our facilities will perform well in respect to both aesthetics and durability.

**Command Standards:**

Air Combat Command standards vary based on whether a finish is permanent or non-permanent. The differentiation is necessary due to annual CAUS color palette changes. Generally permanent finishes last longer and consequently need to be a color that will not become dated after a few years. Non-permanent finishes do not last as long and can be updated as palettes change.

**Permanent Finishes:**

Permanent finishes are generally the hard surface structural interior design (SID) finishes that will last 15 to 20 years and whose removal and re-installation can be costly and may cause a major disruption to the facility. Such items as vinyl composition tile (VCT), ceramic, and other hard surface tiles, plastic laminates, toilet partitions, lockers, window blinds, all modular or systems furniture panels, work surfaces, flipper doors, etc., are considered permanent finishes.

Command standards require that all permanent finishes be in either brown-tone or grey-tone neutrals. These neutral shades can be from very light (such as off-white) to a mid-range neutral of the same shade (taupe). Neutrals with obvious pink, yellow or blue undertones should be avoided.

**Non-permanent Finishes:**

Carpet, paint, vinyl wallcovering, upholstery, artwork, etc. are considered non-permanent finishes. Non-permanent finishes will last from five to seven years under most conditions.

Command standards allow non-permanent finishes to be any coloration appropriate to the facility. Most often these finishes will be in mid-range colorations. Very seldom would there be a use for pastel or very bright colors in ACC facilities.

While non-permanent finishes are permitted in various colors, it is highly recommended that in office and other work areas, vinyl wallcovering or painted wall surfaces be kept in a neutral coloration. Light reflective surfaces are important to a productive work environment. Develop a neutral shell for the interior space of work areas, allowing the carpet, upholstery, artwork and accessories to provide the color accents. Since many facilities frequently change occupants or even function, this neutral shell provides a solid base for future flexibility.

**Finishes and Treatments:**

- Carpet. (See ETL 00-06): Air Force Carpet Standard and the ACC Carpet Guidance. In most facilities a bold tweed or patterned nylon commercial grade loop pile carpet is appropriate. Bold tweed means yarns of several different colors, not various shades of the same color. This allows for several upholstery color combinations within a facility. The majority of yarns must be in mid-range to dark tones to increase the carpet's soil hiding capabilities. In most cases, a dense loop pile is the most hardwearing type of carpet. The face weight should be a minimum of 26 oz/sy. Equally important is the density of a carpet product. Density is a key factor in soiling and resiliency. In an adequately dense pile, dirt will remain on the surface so that it is easily vacuumed away. In addition, more compact fibers are less likely to crush since tufts tend to support each other in the upright position. ACC recommends a minimum density factor of 5,000 for commercial carpets. Refer to ETL 00-06, Table 1 to calculate minimum pile weight to

density ratios. Solution-dyed carpets are recommended for medical facilities, Child Development Centers, lodging facilities and Youth Centers. Olefin and polyester (PET) carpet fibers do not meet heavy or severe wear classifications required for the majority of ACC facilities. Polyester carpet is currently manufactured only in cut pile products and its crush resistance is poor. Olefin and polyester carpeting has limited use in light or moderate wear applications possibly including military family housing.

-- Carpet Tile/6' Vinyl Backed. Use of carpet tile is strongly recommended in office areas with systems or modular furniture. Installation techniques are available which allow carpet tile removal and installation without disassembling systems furniture arrangement. Carpet tile or its associated six-foot wide rolled goods should also be used in corridors. Tile or six-foot vinyl-backed products must be installed with manufacturer's recommended releasable adhesive. Extra tiles or yardage from the same dye lot may be ordered to replace tiles or patch as necessary. Bold tweed patterns or textures help to hide seaming.

-- Solid Carpet/Border. Use of solid-colored carpet is approved only for Distinguished Visitors quarters in lodging facilities. Carpet borders may be solid in color. They may be installed with either carpet tile or roll goods. Do not over-do borders within a facility.

- Hard Surface Flooring. Hard surface or resilient flooring should be used mainly in heavy abuse areas, wet rooms or walk-off areas to provide superior wearability and cleanability.

-- Ceramic Tile, Porcelain Tile, Natural Stone and Cast Stone Flooring. A mottled, flecked or speckled floor tile should be used. Use a medium to dark toned grout which coordinates with the floor tile to hide staining or soiling. Recommend using epoxy grout or grout sealers to maintain appearance. Tile banding accents or patterns are allowed on walls and floors, provided the accent is another neutral shade that coordinates with the dominate tile color. Install with a coordinating base of the same material. Follow manufacturers recommended maintenance instructions. Do not apply wax or other coatings to tile or stone flooring.

-- VCT, Sheet Vinyl, Laminate Flooring, Stratica®, etc. A mottled, flecked, speckled, wood or stone pattern should be used. Avoid very light tones. Install with a coordinating vinyl or rubber base. Laminate flooring is not recommended for commercial applications.

- Vinyl or Rubber Base and Carpet Base. Vinyl or rubber base color should coordinate with the floor or wall surface. Do not use an accent color for the base. A no-toe profile base should be used with carpet tile installations. A four inch carpet base surged with a coordinating thread or capped with a coordinating neutral vinyl or rubber carpet cap can be used in carpeted areas. If carpet base is to be used in place of a vinyl or rubber cove base, it should be the same product that meets the wall whether field or border carpet.

- Vinyl Wallcovering. Type II wallcovering is recommended in most applications for its superior durability and inherent ability to hide wall imperfections. Type I has very limited use in most ACC facilities. A vertical texture or pattern will help hide seaming and a heavy overall texture will hide nail holes or other damage that may occur during the life of the product. Napped material or wall carpet cannot be used as an interior finish.

- Paint. Use a low-sheen, latex enamel for all painted surfaces. Flat paint is difficult to maintain. Use a semigloss finish for trim paint.
- Wainscot and Chair Rail. Wainscot is not recommended in most areas. Dark paneled wainscot has the effect of visually reducing the size of small office spaces, while in hallways it has a railroading effect. A Type II heavy duty vinyl wallcovering installed floor to ceiling will have a better effect. The purpose of chair rail is to protect wall surfaces from being marred by chair backs. Therefore, the chair back height must be considered to properly locate the chair rail. It may be stained or painted to coordinate with the other woodwork or doors. Wainscot and chair rail should be no more than 36" high in rooms and no more than 42" high in corridors. Heavy vinyl bumper guards may also be used to protect walls in corridors where needed. These should be in neutral tones to coordinate with the walls.
- Laminates and Solid Surfacing. Laminate surfaces are more easily maintained if they have a flecked, speckled, mottled, textured or stone look in a matte finish. Soiling and water spotting is nearly invisible on this type of surface. Solid surfacing material (Corian®, Avonite®, etc.) has an extended life cycle and is easily repaired, but is a costly alternative to plastic laminate and should be considered with caution.
- Doors and Door Frames. Depending on the quality of the doors, they may be either stained or painted. If painted, select a color to blend or coordinate with the walls. Paint should be a semigloss finish. It is not recommended to paint doors and jambs in accent colors as this fragments the space. Use artwork, upholsteries, etc. for color.
- Window Blinds. Vertical blinds or metal horizontal blinds should be in off-white or light neutrals. Dark blinds that match the anodized finish of the window frames are acceptable, provided the windows are of reflective glass to prevent heat build-up.
- Ceilings. In almost all facilities, ceilings (whether painted or ceiling tile), are to be white or off-white. Textured ceiling tiles in two-foot squares with a tegular edge are recommended.
- Systems/Prewired Workstations/Modular Furniture. All panel fabrics, work surfaces, flipper doors, etc., are to be in either brown-tone or gray-tone neutrals. Removable tack boards can be purchased in a colored or patterned accent fabric. Only one type of systems furniture should be used per building in order to allow greater flexibility in reconfiguration as occupants' needs change and to provide continuity throughout the space. In open office areas with systems furniture, carpet tile is recommended. Installation techniques are available which allow carpet tile removal and installation without disassembling systems furniture arrangement.
- Interior Signage. Interior Signage should coordinate with the facility color scheme. Neutral colors or brushed metals are preferred in most buildings. Select a style with user-friendly changeable inserts to increase flexibility and life span. Text should be a contrasting color from the background. Type style and size should be easily legible. Ensure that all new signage is ADA compliant.



## **MAINTENANCE AND INSTALLATION**

Always install products according to manufacturer's specifications. Use qualified and reputable installers. Warranties will not be valid unless these are done.

Any finish or furnishing product is only as good as the maintenance it receives. A regular maintenance program is crucial to the longevity of any material used in a facility. In most cases, cleaning and maintenance must conform to manufacturer's instructions to validate warranties.

## **AFFIRMATIVE PROCUREMENT POLICY**

The ACC Affirmative Procurement Policy encourages the purchase/use of items containing recycled materials if the price and availability are reasonable, the item meets reasonable performance specifications, and it would not result in inadequate competition. Use of insulation and cement/concrete containing fly ash is required.

Questions concerning any aspect of architectural or interior design may be directed to Air Combat Command Civil Engineer at ACC/CECT, Commercial (757) 764-3108, DSN 574-3108 FAX (757) 764-5339.

## LANGLEY AIR FORCE BASE LAND MANAGEMENT PLAN

**LAND MANAGEMENT PLAN FOR  
LANGLEY AIR FORCE BASE, VIRGINIA**

For plan period  
July 1999 to July 2004

APPROVING OFFICIALS:

_____	_____
COMMANDER, 1ST SUPPORT GROUP	Date

_____	_____
HQ ACC/CEOO, Agronomist	Date

**INTRODUCTION**

1. Purpose.

The purpose of this Land Management Plan is to provide a comprehensive program for identification and evaluation of the lands under the jurisdiction of Langley Air Force Base. This Plan also specifies the maintenance, conservation and improvement practices necessary on these lands to complement the Composite Constraints and Opportunities Component Plan of the Langley Comprehensive Plan per AFI 32-7062.

Langley Air Force Base land management objectives are: to maintain and improve base grounds for effective control of dust, erosion, and drainage for the purpose of reducing the potential for damage and operational hazards to aircraft, facilities, equipment, and other property involved in the assigned mission; to support installation programs for health, recreation, and welfare of personnel (i.e., quality of life); to provide noise abatement through the judicious use of plant materials; and, to preserve and conserve all lands under Air Force jurisdiction.

2. Description.

a. Location: Langley AFB is geographically located at latitude 37 degrees - 5'N, longitude 76 degrees - 21'W, and is approximately 100 air miles south of Washington, D.C. within the political subdivision of the City of Hampton, Virginia. It is near the southern extremity of the lowest Virginia peninsula at the confluence of the northwest and southwest branches of Back River, a tidal estuary of the Chesapeake Bay.

B. Acreage:

(1) Improved Grounds:

- (a) 100 acres are mowed by base organizations.
- (b) 51 acres are mowed by civil engineering.
- (c) 163 acres are mowed by Military Family Housing occupants.
- (d) 320 acres of Golf Course fairways and greens.
- (e) 294 acres are maintained by service contract.
- (f) 928 total acres of improved grounds.

(2) Semi-improved Grounds:

- (a) 765 acres are maintained by the Civil Engineer Squadron.
- (b) 354 acres are maintained by service contract.
- (c) 1,119 total acres of semi-improved grounds.

## (3) Unimproved Grounds:

- (a) 127 acres of forest lands
- (b) No agricultural outleases
- (c) No grazing outleases.
- (d) 842 acres of other unimproved grounds.
- (e) 969 total acres of unimproved grounds.
- (f) 2 total acres of cultural resource sites.

## (4) Land Under Facilities: 633 total acres are under buildings, roads and parking and airfield pavements.

## (5) Total Acreage of Installation Lands: 3618 acres (total land area).

## 3. Soils, Vegetation, and Climate.

a. Soils Inventory: Langley is comprised of lands which contain large amounts of fill material. Much of the base was previously low lying or originally under water as part of Back River. Other areas required fill to facilitate their use as a bombing range. The fill material has very poor natural fertility and productivity. For this reason, much work is needed in the way of fertilization and soil amendments to have a good ground cover. The soil in the area of Langley is primarily sand, mixed with varying amounts of clay. The subsurface soils have very low standard penetration values, with ground water encountered at approximately 2 to 5 feet below the ground surface. The surface has deposits of loam that vary from between 2 to 6 feet in depth. The sub-surface soils have low standard penetration values (N-Values) through a depth of 25 feet. Ground water is encountered at approximately 2 to 5 feet below the ground surface. A six-foot layer of gray, soft clay (CL) is encountered between 6 to 12 feet. The shallow soils above the gray clay, are orange to tan, very loose to loose silty and clayey sands (SM to SC) with no or little cohesion. While this soil is well drained, it is very susceptible to water and wind erosion. Beneath the clay layer is gray silty fine sand (SM to SP) with marine shell fragments.

b. Surface and Subsoil pH: The soil was tested in April 1991 and the pH ranged from 4.7 to 7.7 with an overall average of 5.9 pH. The locations and results of each sample are at Attachment 1.

c. Native Vegetative Cover: The Langley property was acquired by the Air Force in 1916, at which time the area was characterized by large expanses of agricultural land and marshland, interspersed with woodlands. At the present time, Langley is approximately 8% woodland, and 20% wetlands with the remaining acreage in intensive use for airfield uses, housing, golf courses, and other recreational usage, and miscellaneous administrative and industrial uses.

**ATTACHMENT 1**

<b>SAMPLE</b>	<b>pH</b>	<b>LOCATION</b>
1	6.3	Bldg. 418, lawn and flower beds
2	4.9	Glover and Benedict, Pin Oaks
3	4.8	Bowen across from Bldg. 513A
4	5.6	St. John Circle, beds
5	6.6	Base Chapel (520), lawn
6	6.3	Bldg. 421, lawn
7	6.5	Bldg. 412, lawn
8	6.4	Dodd Blvd., bed #14
9	6.1	Hospital, shrubs
10	6.3	Hospital, lawn
11	6.9	Field west of Eagle Park
12	6.7	TLQ, lawn
13	7.7	Field west of South TLQ area
14	6.9	Bldg. 15, lawn
15	6.5	Bldg. 693, lawn
16	6.0	Bldg. 681, lawn
17	5.5	Clarke Ave. across from Bldg. 869
18	6.7	Lawn around Bldg. 945
19	6.2	LTA Park (814)
20	6.1	LTA Park (864)
21	5.9	Bldg. 801, lawn
22	4.7	Pine Plantation SW of 1300 area
23	5.1	Pine Plantation both sides Poplar Rd.
24	6.1	Pastures, stable area
25	7.0	Greenhouse beds
26	6.9	Base Operation's lawns
27	7.1	Field west of 6th St.
28	7.2	Lawn West Gate along Warehouse Rd.
29	6.0	Field south of Bldg. 18
30	7.4	Memorial Park
31	5.9	Bethel Manor

(1) Woodlands: The woodlands areas are dominated with either pine or sweet gum and are all second growth, characteristic of old field succession and growth since federal acquisition of the area. The wooded areas contain little forest of marketable size, quantity or quality. The only exception is a 12-acre reforested stand of Loblolly Pine. The woodland areas are currently managed for their recreational and wildlife habitat value.

(2) Wetlands: The wetlands at Langley encompass approximately 600 acres and are the only significant area remaining in a natural state. These areas represent a highly valuable resource, since the majority of brackish swamps and salt marshes in the area have been developed. The wetlands on Langley represent a stable ecosystem that is estimated to be 1000 years old. The largest areas of marsh are located along Tabb Creek and along the Northwest Branch of Back River. A smaller area is located along Tides Mill Creek, off of the Southwest Branch of Back River. The marsh area is characterized by seven plant communities generally found in the following order beginning at water's edge:

COMMON NAME	SCIENTIFIC NAME
cord grass	<i>Spartina alterniflora</i>
cord grass, dwarf	<i>Spartina alterniflora</i> -- dwarf form
saltmeadow hay	<i>Spartina patens</i>
salt grass	<i>Distichlis spicata</i>
rush	<i>Juncus roemerianus</i>
marsh elder, high tide bush	<i>Iva frutescens</i>
salt bush	<i>Baccharus halimnifolia</i>

Species distribution is controlled by salinity, drainage, slope, substrate, elevation, and tidal inundation. Due to varying local conditions, there are considerable variations and mixing of plant species through Langley's wetlands.

(3) Main Base: Most of the vegetation in the Main Base area was planted at the time of the base's original construction. Oaks are the dominant species. They are used mainly as street plantings and as decorative plantings around many buildings. The uniformity of size and shape, as well as their fairly regular placement, are a unifying factor throughout these areas, giving this part of the base a distinctive character. Other trees common in this area are magnolia, elms, and maples. These species, along with the oaks, play a major role in breaking up open areas and providing shade for buildings, parking and lawn areas.

Smaller trees used in alignment or as accent plants include crape myrtle and a variety of plum and cherry trees. These work well as decorative plants (by virtue of their form and seasonal interest) within the context of the larger "structural" plants discussed above.

(4) Housing Areas: The main base housing areas show a similar variety of plant materials. The well-developed oaks are used as front yard shade trees and

as street plantings. They are approximately the same size as those in the Main Base area, and are a major identifying factor throughout the area. The rear areas of the housing blocks feature numerous tree species and a variety of shrubs.

The "system" used in these areas is effective and appropriate: formal plantings on the street, which lend a unified "facade", complemented by informal plantings to the rear which frame a common green space. There are many accent plants used within this basic framework.

The Bethel Manor housing areas have few well-developed trees. These areas exhibit a somewhat monotonous pattern of planting which features both fewer plants and less variety of species. Furthermore, the plantings are not effectively placed for maximum effect; rather, they are widely spaced and predictably positioned, usually near the building corners. There are no street plantings and few species that could form a dominant framework as occurs in the main areas of the base.

d. Climatic Data: The climate at Langley AFB is generally characterized by mild winters and warm and humid summers. The mountains to the west and the Chesapeake Bay and Atlantic Ocean to the east are the major factors affecting Langley's climate. The mountains produce various modifying effects on passing storms, while the nearby open bodies of water, which are slow in reacting to seasonal temperature and atmospheric changes, contribute greatly to the humid summers and mild winters.

Daytime high temperatures during the winter season are usually near 50 with nighttime lows in the 30s. Maximum temperatures in the upper 70s and minimums as low as 60 are the extremes during the winter season. The maximum temperature is below freezing on an average of five days each year, while the minimum temperature falls below freezing 13 to 17 days a month during the winter. Daytime highs during the summer are usually in the middle 80s with nighttime lows generally around 70. Maximum temperatures of up to 105, and minimum temperatures in the 50s, are the extremes during July and August. The average date of the last freezing temperature in spring is 25 March, and the average date of the first freeze in fall is 17 November. Freezing temperatures have occurred as late as 21 April and as early as 27 October.

Precipitation is well distributed throughout the year with the maximum in July and August and the minimum in November and April. Monthly totals have ranged from less than 1/4 inch to over 15 inches. Nearly 40 days each year have thunderstorm activity, which is close to the average for the state. In winter, some snow occurs (the average is about nine inches a year), but total snowfall is extremely variable, ranging from none, to nearly 24 inches.

South to southwest winds predominate, but a secondary maximum from a northerly direction reflects the progression of weather systems across the state. Cloudiness is least during the fall season, averaging about 5/10s coverage, and greatest in winter, with 6/10s coverage. Langley, due to its close location to the Chesapeake Bay, is prone to hurricane, tropical storms, and northeasters. To date, when a storm arrives in this area, it has decreased in strength to less than hurricane intensity, but still causes considerable damage from high winds and heavy rains. Tornadoes are quite rare, but one struck the base during 1993 and caused limited damage.



Thunderstorms, accompanied by lightning, hail and high winds are much more frequent and produce the greatest amount of storm damage in the area.

e. Narrative: Langley is located just about on the line of the cool humid region and warm humid region with approximately 230 days of growing season. A combination of mixed regions and poor soil makes grounds maintenance at Langley a difficult task.

#### 4. Establishing Vegetation.

a. Preferred Planting Seasons: Planting should be done when the ground is not frozen, snow covered, or in an otherwise unsuitable condition for planting. The planting seasons are as follows:

(1) Deciduous material from 1 March to 15 April for spring; and from 15 September to 15 December for fall planting.

(2) Evergreen material from 1 March to 15 May for spring and from 1 October to 15 December for fall planting.

(3) Cool-season grass seed from 15 August to 1 October for fall planting.  
Warm-season grass seed from 1 May to 15 Jun for spring planting.

b. Mulch Requirements: Shredded hardwood mulch shall be used as the mulching material. Within 2 days after planting, plants shall be mulched with a layer of shredded hardwood mulch material covering the entire planting bed to a depth of 2 to 3 inches. Mulch shall be kept off of the crowns of shrubs. Provide "Tyvek" or equal weed screen under mulched areas. Other types of mulch may be used only at the direction of the Base Civil Engineer.

c. Plant Species: Native plant materials are preferred over exotics as those materials tolerate the regional environmental conditions that limit exotics. When possible, native plant species are installed in landscape renovation and new facility projects. Plants shall be nursery grown or plantation grown stock and shall be of the varieties specified in the plant list that follows this section. Plant material shall be well-branched and well-formed, sound, vigorous, healthy, and free from disease, sun-scald, windburn, abrasion, and harmful insects or insect eggs and shall have healthy, normal, and unbroken root systems. Deciduous trees and shrubs shall be symmetrically developed of uniform habit of growth, with straight boles or stems, and free from objectionable disfigurements. Evergreen trees and shrubs shall have well developed symmetrical tops with typical spread of branches for each particular species or variety. Ground covers shall be vigorous, with well developed runners. Plants shall have been grown under climatic conditions similar to those of Langley. Plants budding into leaf or having soft growth shall be sprayed with an antidesiccant at the nursery before digging. Plants shall be dug and prepared for shipment in a manner that will not cause damage to branches, shape, or future development. Balled and burlapped, and balled and potted plants shall have ball sizes conforming to ANSI Z60.1. Plants shall be balled with firm natural balls or soil,

and shall be wrapped firmly with burlap, strong cloth, or plastic, and tied. Container grown plants shall have sufficient root growth to hold earth intact when removed from containers, but shall not be root bound.

**TREES (SELECTED FOR SHADE AND BEAUTIFICATION)**

COMMON NAME	SCIENTIFIC NAME
Ash (Newport)	<i>Fraxinus var.</i>
Bald Cypress	<i>Taxodium distichum</i>
River Birch	<i>Betula nigra</i>
Cedar (Blue Atlas)	<i>Cedrus var.</i>
Cherry (Yoshino, Kwansan, Okame)	<i>Prunus var.</i>
Dogwood (Pink, White)	<i>Cornus florida</i>
Ginkgo (male only)	<i>Ginkgo biloba</i>
Hackberry (Sugar)	<i>Celtis var.</i>
Hawthorn (Washington, Winter King)	<i>Crataegus var.</i>
Holly, American	<i>Ilex opaca</i>
Linden Greenspire	<i>Tilia Cordata</i>
Magnolia (Grandiflora, Sweetbay)	<i>Magnolia var.</i>
Maple	<i>Acer var.</i>
Oak (Willow, Live, Pin)	<i>Quercus var.</i>
Pear (Bradford, Aristocrat)	<i>Pyrus var.</i>
Plum (Purple Leaf)	<i>Prunus var.</i>
Pine, (Loblolly, Slash, Mugho)	<i>Pinus var.</i>
Redbud, Eastern	<i>Cercis canadensis</i>
Spruce (Norway, Alberta)	<i>Pinus var.</i>
Tallowtree, Chinese	<i>Sapium sebiferum</i>
Willow, Weeping	<i>Salix babylonica</i>
Yellow-Poplar	<i>Liriodendron tulipifera</i>
Zelkova	<i>Zelkova serrata</i>

**SHRUBS AND VINES (SELECTED FOR SCREENING AND BEAUTIFICATION)**

<b>COMMON NAME</b>	<b>SCIENTIFIC NAME</b>
Abelia (Grandiflora)	<i>Abelis var.</i>
Azalea	<i>Rhododendron var.</i>
Barberry (Crimson, Red Leaf)	<i>Berberis Thunbergi</i>
Boxwood (American, English)	<i>Buxus var.</i>
Camellia	<i>Camellia var.</i>
Cleyera Japonia	<i>Cleyera japonica</i>
Euonymus (Golden, Altus Compacta)	<i>Euonymus var.</i>
Forsythia	<i>Forsythia var.</i>
Hawthorn (Snow White, Pink Lady)	<i>Crataegus var.</i>
Holly	<i>Ilex var.</i>
Hydrangea (Oakleaf, Calycinum)	<i>Hydrangea macrophylla</i>
Jasmine (Confederate, Flordia)	<i>Trachelaspermum var.</i>
Juniper (Blue Haven, Cologreen)	<i>Juniperus var.</i>
Laurel (Cherry, Otto Luykens)	<i>Prunus laurocerasus</i>
Ligustrum, Waxleaf	<i>Ligustrum japonicum</i>
Crape Myrtle	<i>Lagerstroemia indica</i>
Nandina (Domestica, Nana Purpurea)	<i>Nandina domestica</i>
Oleander	<i>Nerium oleander</i>
Photinias	<i>Photinia var.</i>
Pittosporum (Tobira Green, Wheelers)	<i>Pittosporum tobira</i>
Viburnums (Tinus, Japonica, Davidii)	<i>Viburnum var.</i>
Wax Myrtle	<i>Myrica cerifera</i>
Yaupon, Holly	<i>Ilex voimtoria</i>

**GRASSES AND GROUND COVERS**  
(SELECTED FOR EROSION CONTROL, LAWNS AND PLAY AREAS)

COMMON NAME	SCIENTIFIC NAME
Ajuga (Reptans)	<i>Ajuga var.</i>
Bermuda grass, Common	<i>Cynodon dactylon</i>
Clover (Crimson)	<i>Trifolium var.</i>
Daylily	<i>Hemerocallis var.</i>
Perennial Ryegrass	<i>Lolium perenne</i>
Fescue, Tall	<i>Festuca arundinacea</i>
Hosta	<i>Hosta var.</i>
Liriope	<i>Liriope muscari</i>
Mondo (Monkeygrass)	<i>Ophiopogon japonicus</i>
Ryegrass, annual	<i>Lolium multiflorum</i>
St. Augustine-grass	<i>Stenotaphrum secundatum</i>

d. Seed Mixtures and Seeding Rate:

- (1). Seed: Pure live grass seed mixture containing weed seed less than 0.01 percent by weight of the total mixture. Do not use seed that has become wet, moldy or is otherwise damaged.

SEED MIX*	PURE LIVE SEED % MIX
Perennial ryegrass and common Bermuda	100
TOTAL PERCENT OF PURE LIVE SEED MIXTURE: 100	

- (1) Seeding: Sow seed uniformly at a rate of 8 to 10 lbs. of pure live seed mix per 1,000 sq. ft. by means of drill machine seeders (broadcasting), or hydroseeders. One half of the seed shall be sown in one direction, and the remainder shall be sown at right angles to the first sowing. The seed shall be covered to an average depth of 1/4 inch by means of spike-tooth harrow, cultipacker, or other approved device. Seed shall not be broadcast when winds are above 10 mph.

- (2) Hydroseeding: The seed, fertilizer, and approved mulch material shall be mixed in the required amount of water to produce a homogeneous slurry and then uniformly applied. The seed mixture shall be as follows with weed seed less than 0.01 percent:

<b>SEED MIX*</b>	<b>PURE LIVE SEED % MIX</b>
Common Bermuda (hulled / unhulled)	50
Perennial Ryegrass	50
<b>TOTAL PERCENT OF PURE LIVE SEED MIXTURE:</b>	<b>100</b>

(3) **Ground Preparation:** Prior to seeding, clear area of vegetation, stumps, and other debris. Maintain previously established grades in a true and even condition. Till the soil to a depth of at least 6-inches. and remove all stones larger than 3-inches in diameter.

e. **Sod:** Sod shall be machine cut with a uniform soil thickness of 3/4 inch, plus or minus 1/2-inch at the time of cutting. Measuring for thickness shall exclude top growth and thatch. Broken pads and torn or uneven ends are not acceptable. Sod shall be obtained from approved sources where the sod is heavy and dense. The sod shall be harvested, delivered and installed within a period of 36 hours. Sod shall have been grown under climatic conditions similar to Langley. The sod shall be free of weeds or other detrimental material, and will not be heat damaged.

Immediately prior to sodding, all areas to be sodded shall be watered, wetting the soil to a depth of 4 inches. Sod shall be laid at right angles to slopes or the flow of water. When spot sodding, the sod shall be cut into plugs 2 inches square or 2 inches in diameter. The individual pieces of sod shall be placed on 12-inch centers and pressed firmly into the soil by foot pressure or by tamping. After sod pieces have been placed in position, the sodded area shall be rolled or tamped such that air pockets are eliminated, and the edges shall blend smoothly into the surrounding area.

f. **Fertilizer:** Fertilizer shall be commercial grade, free flowing, and uniform in composition and shall conform to applicable state and Federal regulations. Fertilizing shall be done between 1 September and 15 October for the Perennial Ryegrass and beginning in Mid-March through July for the Common Bermuda Grass per our General Officer Quarters Turf Management Plan. Fertilizing in the fall develops a strong root system which helps the grass withstand drought and diseases. Fertilizer is only used as determined by the soil analysis. Apply fertilizer with contents recommended by the soils analysis at the below general guidelines, however, each soil analysis will provide the rate and formulation for application.

<b>TURF</b>	as specified by soil test and specific turf program
<b>TREES</b>	1 pound/inch caliper
<b>SHRUBS</b>	1 pound/18" height or spread of shrub
<b>BED AREAS</b>	as specified under bed preparation

Fertilizer will be applied each year by the Civil Engineer Squadron/approved contractor to all General Officer Quarters properties and select improved grounds and approximately 180 acres of semi-improved grounds, which include athletic fields, a 100 foot strip along major roads, and other high use areas. In addition, fertilizer is supplied to base housing occupants for their use.

g. Soil Amendments (applied only as directed by soil analysis):

- (1) Agricultural Limestone: Limestone shall have a minimum calcium carbonate equivalent of 90 percent and shall be ground such that at least 90 percent will pass through a 10- mesh sieve and at least 50 percent will pass through a 60-mesh sieve. Coarser materials are acceptable provided they pass through the 10-mesh sieve and the specified rates of application rate increase in linear proportion to the quantities passing through the 60-mesh sieve, where zero passage indicates doubling the application rate.
- (2) Other Liming Material: Other liming material shall be crushed to such a fineness that at least 90 percent will pass through a 9-mesh sieve and at least 80 percent will pass through a 10-mesh sieve.
- (3) Aluminum Sulfate: Aluminum sulfate shall be commercial grade.
- (4) Sand: Sand shall be clean and free of toxic materials and at least 95 percent by weight shall pass through a 60-mesh sieve, and 10 percent by weight shall pass through a 16-mesh sieve.
- (5) Manure: Dried manure shall be unleached stable or cattle manure containing not more than 10 percent by volume of straw, sawdust, or other bedding materials and containing no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds.
- (6) Sawdust: Rotted sawdust shall have 7.5 pounds of nitrogen added uniformly to each cubic yard and shall be free of chips, stones, sticks, soil and toxic substances.
- (7) Sulphur: Sulphur shall be commercial grade.
- (8) Peat: Peat moss shall be a European sphagnum peat moss, consisting of partially decomposed vegetable matter of natural occurrence. It shall be brown in color, clean, low in content of mineral and woody material, mildly acid, and may be either granulated or shredded.
- (9) Vermiculite: Vermiculite shall be horticultural grade and free of any toxic materials.

## 5. Maintenance of Lands.

a. Improved Grounds: Improved grounds are those on which intensive maintenance activities are annually planned and performed. These are developed areas of an installation that have lawns and landscape planting that require intensive maintenance. These include the Headquarters ACC or HTA area, the Distinguished Visitor route, General Officer Quarters, Memorial Park, and the golf course. Areas that are improved grounds, but receive a slightly lesser degree of maintenance are the LTA and Shellbank areas, Eagle Park, athletic fields, and all housing areas.

(1) Ground Cover: Bermuda grass (*Cynodon dactylon*) and Tall Fescue (*Festuca*) are the predominate turf grasses. Minor species present are Dallis grass (*Paspalum dilatatum*), Crabgrass, Orchard grass (*Dactylis glomerata*), and Bluegrass (*Poa*). Various mixtures occur in different areas of the Base depending on the care given by the agency or individual responsible for maintaining the area. A lack of uniformity is the biggest deterrent in maintaining a good appearance of lawns. Perennial Ryegrass is used for all new areas and in the over-seeding of thin, weak, turfing areas. Approximately 40 acres of Bermuda grass lawns require overseeding with Perennial rye grass for improved winter appearance.

(2) Maintenance Practices:

(a) Fertilization and Soil Amendment: Based on the soil analysis reports, fertilization is accomplished in the fall for fescue and ryegrass species to develop a strong root system, which helps the grass withstand drought and diseases. Fertilizing should be done between September 15 to 30 October. Spring and summer fertilization occurs on the Bermuda grass warm season grass species. Since Langley is within the Chesapeake Bay Watershed, we apply slow release fertilizers in PPSCU (poly plus sulfur coated urea) formulations to ensure that no more than 1 lb. of Active nitrogen is applied at any one time. Lime is applied as annual soil testing dictates. Pelletized lime is used.

(a) Mowing: Average mowing heights on Langley are as follow: For the majority of the base the mowing height is 2.5"-3" height. For Benedict Avenue where we have a Common Bermuda grass as our warm season grass, we maintain the grass to 2" height. Frequency of mowing is controlled by growth of the lawn and is limited to removal of no more than one third of the existing leaf growth at one mowing. Minimum limit on mowing height is effective by insuring that all machines are used at the adjustment setting determined by the grounds superintendent. Improved grounds and family housing areas are inspected weekly for appearance, including height of cut.

(c) Irrigation: Irrigation is performed by base housing occupants on approximately 150 acres of residential areas, building occupants in

administrative areas, and by automated irrigation systems in some highly visible areas and portions of the golf courses. Watering in the early morning or late evening is most effective for lawn care. Three inches per month is the minimum water requirement for maintaining turf grass during the three warmest months if drought conditions occur. Base policy prevents waste of water by restricting irrigation to alternate days and specified hours during drought periods. Further restriction may be imposed due to fire emergencies, loss of water supply or drought.

(d) Weed and Brush Control: The control of weeds and brush on the base is the responsibility of the Civil Engineer Squadron's Entomology shop. The various herbicides, their uses, and frequency are listed below:

Soil-Sterilant	Several soil sterilants are used in limited amounts on the base to control weeds and brush along remote fence lines, transformer enclosures, and other areas as necessary. The sterilants are used on an as needed basis and are Bromcil and Pramital.
Selective Herbicides	Selective herbicides are used in the improved areas of the base for the control of broadleaf weeds and other grassy weeds. The selective herbicides used are 2-4-D and Weedone DPC. 2-4-D is used in the early spring and late fall.
Other Herbicides	In addition to the soil sterilants and selective herbicides, Round-up is used as a non-selective where a total plant kill is required without the use of a sterilant.

(e) Insect and Disease Control: Insect control, like weed and brush control, is the responsibility of The Base Civil Engineer's Entomology Shop. The insect problems and treatments as they relate to land management are described below. Specific application rates can be obtained from the Entomology shop.



Turf Pest Control	Pests in turf grasses are divided into two types: fungi and insects. The most common fungus problems are Brown Patch, Dollar Spot, and Fairy Ring, which are all common. The treatment utilized is Daconil 2787 and is used as problems occur. The common grass insect problem is caused by grubworms, which are generally treated with Oftanol or Carbaryl.
Ornamental or Tree Control	The most common pest problems with ornamental trees and shrubs are Aphids, Bagworms, and Tent Caterpillars. All three are treated with a general application of Carbaryl. Other pests that occur that require spot treatments are Webworms, Locust Borers, Beetles, and Japanese Beetles. These are all treated with spot applications of Malathion or Carbaryl.

(f) Rodent Control: Rodents, such as field mice, ground squirrels, pocket gophers, and moles, have caused little damage to vegetation and created few hazards on airfield grounds by burrowing and creating mounds. The control of rodents is performed on an "as required" basis, and only by certified Pest Management personnel.

(g) Pruning: Trees and shrubs are pruned once yearly, normally during December, January or February. Clearances from buildings, utilities, and other structures shall be no less than one foot. Pruning must be accomplished in accordance with the requirements of the particular species. Conifers and most broadleafed evergreens, such as holly and magnolia, should not be pruned at the base of the plant unless the tree becomes large enough for use as shade. Shrubs and trees should be allowed to assume their natural shape and not be cropped or pruned to a uniform level in a round, flat-topped, or other unnatural form. Prune shade trees gradually from the base, pruning away not more than two feet up the main trunk per year until a desirable height is reached. Prune deciduous shade trees to a single trunk during periods of early growth. All branches less than 14 feet over streets, 12 feet over driveways, 8 feet over walkways, and 4 feet over buildings shall be pruned back. Pruning must be done under careful supervision and only by experienced personnel either from the Civil Engineer Squadron or their contractor. Removing dead, broken, or diseased wood is all that should be required on most established trees and shrubs.

b. Semi-Improved Grounds: Semi-improved grounds are those where periodic maintenance is performed primarily for operational and aesthetic reasons (such as erosion control, bird control, and visual clear zones). These include grounds adjacent to

runways, taxiways, and aprons; AICUZ clear zones; lateral safety zones; rifle and pistol ranges; munitions storage areas; antenna facilities; golf course roughs, etc.

(1) Ground Cover: Turf in the semi-improved areas consists primarily of volunteer native vegetation consisting of Bermuda grass, Tall Fescue, Lespedeza, and Dallis grass.

(2) Maintenance Practices:

(a) Mowing: Average mowing heights are as follow: Main base open fields, 2.5-3"; 100' strip on both sides of Perimeter Road, 3"; and airfield, 9"-14". Frequency of mowing is limited to removal of no more than one third of the existing leaf growth at one mowing. Minimum limit on mowing height is effective by insuring that all machines are used at the adjustment setting determined by the grounds superintendent or base operations officer. In accordance with recommendations contained in a Bird/Aircraft Strike Hazard Survey Report, grass height on the airfield is maintained at 9-14". This taller grass reduces ground maintenance costs and makes the areas unsuitable for use by birds.

(c) Other Maintenance: Refer to the Improved Grounds section for information on irrigation, weed control, insect/disease control and rodent control.

c. Unimproved Grounds: All grounds not classified as Improved or Semi-Improved are considered Unimproved Grounds. Unimproved land consists of approximately 600 acres of wetlands (marsh); 115 acres of woodland; and 12 acres of 14-year old Loblolly Pine plantation. The native vegetation that exists in the Unimproved Grounds is discussed under Section 2. The only maintenance practices in these areas are removal of debris from wetlands during annual "Clean the Bay Day" activities and other emergency erosion or vegetation control as required.

## 6. Instructions to Occupants.

Grounds maintenance responsibilities and instructions to housing occupants are included in the Family Housing booklet provided to all tenants. The following is the grounds maintenance instructions given in the booklet:

STANDARDS FOR MILITARY FAMILY HOUSING	
ITEM	STANDARD
GRASS MOWING	<p>Proper mowing is most important to maintain a healthy, vigorous turf. A sharp, well-adjusted mower should be used to avoid tearing the blades of grass, thus creating an off-color appearance.</p> <p>Grass should be maintained no lower than 1-1/2" in height for our warm season Bermuda species. For the cool season annual ryegrass</p>

<b>STANDARDS FOR MILITARY FAMILY HOUSING</b>	
<b>ITEM</b>	<b>STANDARD</b>
	<p>recommend a minimum of 2-1/2" –3" height.</p> <p>Clippings, unless heavy, should be left on the ground. Grass will be mowed to a minimum distance of 50' in all directions or to a midway point between buildings, parking lots, roads, and operating areas (This distance does not preclude the maintenance of areas beyond the 50' distance, if good judgment dictates).</p>
EDGING OF GRASS ALONG SIDEWALKS, PATIOS, DRIVEWAYS AND ROADWAYS	<p>Sidewalks, patios, driveway parking areas and roadways must be edged in such a manner as to keep them free of grass.</p> <p>The use of power edgers/hand edgers provide satisfactory results. Do not use a spade or shovel to "trench" along paved areas. Cut should not exceed 3/4" in width from the paved surface for safety reasons. All grass should be removed from cracks in sidewalks, driveways, parking spaces, and doorsteps.</p>
TRIMMING OF GRASS AROUND FOUNDATIONS	Trim grass around foundation of house, door steps, shrubbery, etc.
GARDENS	<p>Prior to, but not later than 1 November annually, garden plots will be stripped of vegetation, graded level and seeded with a good quality lawn seed to ensure restoration of turf during the fall growing season.</p> <p>Initially, garden plots must be approved by the Housing Office on an AF Form 332 and require a digging permit. Size is restricted to a 10' x 10' area.</p>
FLOWERS	<p>Planting of flowers is encouraged as long as there is no interference with permanent landscape planting.</p> <p>Flowers should be planted adjacent to the home, patio, driveway, or in cultivated flower beds.</p>
PERENNIAL PLANTS	Perennial plants, such as rose bushes, azaleas, and evergreens, etc., may be left at the quarters at the time of termination provided they are in good health, well-maintained, and pose no threat of damage to quarters, utilities, sidewalks, driveways, etc.
SHRUBBERY/ TREES	Shrubbery should be maintained at an approximate height of four feet or less depending on type of shrub. Trimming of shrubbery includes removal of dead or broken branches and cutting back of shrubs to keep them within bounds. Proper pruning is required to give balanced growth and desired appearance.

STANDARDS FOR MILITARY FAMILY HOUSING	
ITEM	STANDARD
	<p>Trees which are in the occupant's area of responsibility and are within reach should be pruned so as to avoid safety problems; especially adjacent to sidewalks or other heavy traffic areas.</p> <p>Digging to plant shrubbery, trees, etc., should not be done until approved on an AF Form 332 and a digging permit is issued. Planting new hedges must also be approved on an AF Form 332. Healthy trees/shrubbery planted by the base may not be removed by occupants.</p>
REMOVAL OF DEBRIS	Occupants are responsible for policing the grounds around their quarters up to a minimum distance of 200 feet in all directions or to a midway point between buildings. The lawn must be free of debris (paper, cans, candy wrappers, etc.). Additionally, items such as tires, plywood, or other miscellaneous items leaning against houses, carports or privacy fences must be removed and stored. Occupants are responsible for any littering by dependents or guests on base or in the military family housing area.
SNOW/ICE REMOVAL	Remove snow and ice "as needed" from sidewalks and driveways.

7. Golf Course Maintenance.

- a. Personnel Assigned: There are twelve full-time maintenance personnel; one superintendent and nine part-time summer overhires assigned to the golf courses.
- b. Available Equipment: Equipment required for day-to-day maintenance is assigned to the Golf Course from the Grounds Section. Included are a Greens' Mower, Fringe and Tee Mower, Verticutter, aerator, Top-dresser, Sweeper Fertilizer Spreader, and Fairway Mower. Other equipment such as tractors, dump trucks, spray tanks, etc., are furnished by the Base Civil Engineer Squadron. Materials such as fertilizer, herbicides, fungicides, etc. are centrally located and used as required.
- c. Recurring Maintenance:
  - (1) Mowing:
 

Greens: daily, height 3/16"

Tees: 3 times weekly, height 3/4"

Fairways: 3 times weekly, height 5/8"

Fringe: 3 times weekly, height 3/4"

Roughs: weekly, height 1 1/2"

Verticutting:

Greens: Twice monthly during summer and fall.

(2) Irrigation:

Greens: 1/4" daily

Fairways: 1/4" daily

Tees: 1/4" daily

(3) Fertilizing and Soil Amendments:

Greens: Every 6 weeks, during growing season

(4) Disease Control: Preventative fungicide applications are applied as prescribed by a Scotts chemical program. Additional treatment is on an as required basis.(5) Aeration of Fairways and Greens:

Greens: four times between March and September

Fairways: once a year

Tees: every 6 weeks

(6) Topdressing: Topdressing consists of a mixture of 70% sand and 30% peat and is applied to greens and tees monthly.(7) Weed Control: 2-4-D and Weedone DPC are used as selective herbicides when needed.

## 8. Fire Suppression.

There are no fire breaks and controlled burning is not needed on the base. Because of the high annual rainfall, fire suppression is not a significant factor in land management practices.

## 9. Environmental Pollution Prevention.

All pest control technicians receive instruction by Air Force Tech schools on disease vector control and herbicide application. After the minimum required experience, they are recommended to the ACC Entomologist for certification. The shop supervisor attends all state and/or EPA school conferences on training and is certified by the state under an approved EPA certification plan.

All modifications and/or revisions to this plan are reviewed by the Base Environmental Coordinator (CEVE) and the Environmental Protection Committee for completeness and

scientific accuracy prior to implementation so as to prevent any air, water or soil pollution due to land management activities.

10. Erosion and Sedimentation Control.

All construction and maintenance practices will comply with the provisions of Virginia Erosion and Sediment Control Law, as outlined in their handbook, 3rd Edition, 1992. This action will reduce soil erosion and pollution of the Back River, ensure compliance with approved abatement for non-point sources of water pollution from erosion runoff, and enable Langley to meet state and local sedimentation and runoff control regulations.

11. Off-Road Vehicle Control.

Due to potential adverse environmental impact, off-road operation of vehicles for recreational use is prohibited on Langley and the Bethel Manor Housing Areas by LAFB Supplement 1 to AFR 19-4.

12. Multiple-use Coordination.

The Outdoor Recreation Plan, and Fish and Wildlife Plan, have been reviewed and are compatible with this plan. The Land Management Plan does not interfere with or hamper any activities or management practices on the base.

13. Floodplains and Wetlands.

The majority of Langley, with the exception of the airfield area, is located within the 100-year floodplain. In addition, Langley has approximately 600 acres of wetlands, all of which are within the floodplain. Langley is also susceptible to high tide surges during storms and spring tides. A tidal surge of 7.8 above Mean Sea Level (MSL) occurred in April of 1978. The high tide surge elevation, 100-year floodplain, and known wetlands are identified on the map at Attachment C.

All facilities planned for construction within the floodplain are constructed above the flood elevation. No facilities are planned within the wetlands. Applicable wetlands permits from the US Army Corps of Engineers, the Virginia Marine Resources Commission, and the Hampton Wetlands Board are obtained for all management practices, i.e. rip-rap installation, that will or could affect tidal or nontidal wetlands. All development must also comply with the Chesapeake Bay Preservation Act and associated state and local laws and ordinances.

14. Prime and Unique Farmlands.

The US Soil Conservation Service surveyed Langley in February 1985 and designated two sites as prime farmland. One site is approximately 22 acres and is a wooded area which is also a wetland. The second site is approximately 17 acres in size and currently is used as a horse pasture. There are no development plans that would curtail their future use for agricultural purposes. The areas are shown on the map at Attachment B.

## 15. Environmental Assessment.

This Land Management Plan has been assessed in accordance with AFR 19-2. It was determined that the plan had no adverse environmental effects and qualified for a CATEX Determination under activity Type A. Copies of the environmental documentation is available for review in the 1 CES/CEV office.

## 16. Attachments.

- 1) Soil Sample Locations
- 2) Grounds Classification Map w/ Prime and Unique Farmlands
- 3) Wetlands/Floodplains Map w/ High Tidal Surge
- 4) Climatology Data

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**PLANT LIST**



**Large Deciduous Trees.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
October glory red maple	<i>Acer rubrum</i> 'October glory'	50-80/40-50
sugar maple	<i>Acer saccharum</i>	10-75/40
common hackberry	<i>Celtis occidentalis</i>	30-50/25-40
American beech	<i>Fagus grandifolia</i>	80-100/50-70
European beech	<i>Fagus sylvatica</i>	80-100/50-70
marshall's seedless green ash	<i>Fraxinus pennsylvanica</i> 'Marshall's seedless'	60/40
shademaster thornless honey locust	<i>Gleditsia triacanthos intermus</i> 'Shademaster'	40/35-40
tulip poplar	<i>Liriodendron tulipifera</i>	60-100/30-40
sour gum, black tupelo	<i>Nyssa sylvatica</i>	70-100/40-60
sawtooth oak	<i>Quercus acutissima</i>	35-40/30-35
scarlet oak	<i>Quercus coccinea</i>	70/40-50
chestnut oak	<i>Quercus michauxii</i>	80/30-40
willow oak	<i>Quercus phellos</i>	70/30-40
pyramidal English oak	<i>Quercus robur fastigiata</i>	80/30
red oak	<i>Quercus rubra</i>	70/30-40
callery pear varieties	<i>Pyrus calleryana</i>	50-60/15-20
pondcypress	<i>Taxodium ascendens</i>	40-50/15-20
baldcypress	<i>Taxodium distichum</i>	60-100/30-50
greenspire linden	<i>Tilia cordata</i> 'Greenspire'	30-50/30
Green Vase zelkova	<i>Zelkova serrata</i> 'Green Vase'	80/80

**Large Evergreen Trees.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
atlas cedar	<i>Cedrus atlantica</i>	40-60/30-40
blue atlas cedar	<i>Cedrus atlantica glauca</i>	40-60/30-40
deodara cedar	<i>Cedrus deodara</i>	60-100/40-50
cedar of lebanon	<i>Cedrus libani</i>	75/50
leyland cypress	<i>Cupressocyparis leylandii</i>	60-70/10-15
Italian cypress	<i>Cupressus sempervirens</i>	60/5-8
hinoki cypress	<i>Chamaecyparis obtusa gracillis</i>	100/20-30
sawara cypress	<i>Chamaecyparis pisifera</i>	100/20
white cedar	<i>Chamaecyparis thyoides</i>	100/40
cryptomeria	<i>Cryptomeri japonica</i>	100/25-30
southern magnolia	<i>Magnolia grandiflora</i>	80-100/50-80
sweet bay magnolia	<i>Magnolia virginiana</i>	60/20-40
slash pine	<i>Pinus elliotii</i>	75-100/30-40
longleaf pine	<i>Pinus palustris</i>	80-100/30-40
loblolly pine	<i>Pinus taeda</i>	75-100/30-40
darlington oak	<i>Quercus laurifolia Darlingtonia</i>	50/40-50
live oak	<i>Quercus virginiana</i>	40-80-/60-100

**Small Deciduous Trees.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
amur maple	<i>Acer ginnala</i>	20/20
paperbark maple	<i>Acer griseum</i>	20-30/15
Japanese maple	<i>Acer palmatum</i>	20/20
June berry	<i>Amelanchier arborea</i>	20-30/12-15
river birch	<i>Betula nigra</i>	20-40/16-20
Chinese redbud	<i>Cercis chinensis</i>	15/10-15
flowering dogwood	<i>Cornus florida</i>	15-30/12-20
cornelian cherry	<i>Cornus mas</i>	20-25/15-18
Washington hawthorn	<i>Crataegus phaenopyrum</i>	25-30/20-25
franklinia	<i>Franklinia altamaha</i>	20-30/15-20
Carolina silverbell	<i>Halesia carolina</i>	30/20
golden rain tree	<i>Koelreuteria paniculata</i>	20-30/25-35
flame tree	<i>Koelreuteria bipinnata</i>	40-60
crape myrtle hybrid	<i>Lagerstroemia indica</i> X <i>L. fauriei</i>	30/15-20
saucer magnolia	<i>Magnolia soulangeana</i>	25/30
star magnolia	<i>Magnolia stellata</i>	15-20/15-20
flowering crabapple	<i>Malus floribunda</i>	25/25
sourwood	<i>Oxydendrum arboreum</i>	20-40/10-15
purple-leaf plum	<i>Prunus cerasifera pissardi</i>	15-30/20-25
kwanza cherry	<i>Prunus serrulata</i> 'Kwanza'	15-25/15-20
weeping cherry	<i>Prunus subhirtella pendula</i>	15-20/10-15
pussy willow	<i>Salix caprea</i>	12-25/8-15
torture twig willow	<i>Salix matsudana tortuosa</i>	40/20-30
common sassafras	<i>Sassafras albidum</i>	30-40/20-25
showy stewartia	<i>Stewartia ovata</i>	15/8-10

**Small Evergreen Trees.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
loblolly bay	<i>Gordonia lasianthus</i>	30/15
English holly	<i>Ilex aquifolium</i>	10-20/6-12
dahoon holly	<i>Illex cassine</i>	20-30/10-15
lusterleaf holly	<i>Ilex latifolia</i>	15/7-11
myrtle leaved holly	<i>Ilex myrtifolia</i> 'Lowii'	20/7-9
Nellie R. Stevens, holly	<i>Ilex</i> 'Nellie R. Stevens'	15-25/10-15
American holly	<i>Ilex opaca</i>	30/12-20
Foster's American	<i>Ilex opaca</i> 'Fosteri'	40/12-20
pernyi holly	<i>Ilex pernyi</i>	20/8-10
sparkleberry & apollo holly	<i>Ilex serrata</i> X <i>verticillata</i>	15/10-15
Yaupon holly	<i>Ilex vomitoria</i>	15-20/5-10
anisetree	<i>Illicium anisatum</i>	15/8-10
spartan juniper	<i>Juniperus chinensis</i> 'Spartan'	15-20/6-8
skyrocket juniper	<i>Juniperus scopulorum</i> 'Skyrocket'	25/6-8
silver cedar	<i>Juniperus virginiana</i> 'Glauca'	20-25/8-12
fortune osmanthus	<i>Osmanthus</i> X <i>fortunie</i>	20/15
holly osmanthus	<i>Osmanthus heterophyllus</i>	15-20/12-18
red tip photinia	<i>Photinia fraseri</i>	20-30/15-20
yew podocarpus	<i>Podocarpus macrophylla</i>	30/5-20
Carolina cherrylaurel	<i>Prunus caroliniana</i>	20-30/15-20
pyramidal arborvitae	<i>Thuja occidentalis</i> 'Pyramidalis'	25/10
oriental arborvitae	<i>Thuja orientalis</i>	18-25/10-12

**Deciduous shrubs.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
flame azalea	<i>Azalea calendulaceae</i>	8-15/5-8
butterfly-bush	<i>Buddleia davidii</i>	8-12/6-8
Carolina allspice	<i>Calycanthus floridus</i>	6/5-8
Japanese flowering quince	<i>Chaenomeles speciosa</i>	6/6
sweet pepperbush	<i>Clethra alnifolia</i>	3-10/3-8
pride of Rochester	<i>Deutzia scabra</i>	15/10-12
burning bush	<i>Euonymus alata</i>	8-10/8-10
pearl bush	<i>Exochorda racemosa</i>	10-15/10-15
forsythia	<i>Forsythia intermedia</i>	8-10/10-12
Chinese witch-hazel	<i>Hamamelis mollis</i>	10-12/5-6
rose of Sharon	<i>Hibiscus syriacus hybrids</i>	8-10/3-5
bigleaf hydrangea	<i>Hydrangea macrophylla</i>	4/4
oakleaf hydrangea	<i>Hydrangea quercifolia</i>	6-7/6-8
winter berry	<i>Ilex serrata x verticillata</i>	6-8/3-5
Virginia sweetspire	<i>Itea virginica</i>	3-5/5-8
winter jasmine	<i>Jasminum nudiflorum</i>	2-4/3-5
bush cinquefoil	<i>Potentilla fruticosa</i>	2-4/3-5
dwarf pomegranate	<i>Punica granatum nana</i>	12-15/12
double bridal wreath	<i>Spirea prunifolia</i>	4-6/5-8
baby breath	<i>Spirea thunbergi</i>	3-5/3-5
Persian lilac	<i>Syringa persica</i>	6-8/7-9
fragrant viburnum	<i>Viburnum carlesi</i>	6-8/4-6
European highbush cranberry	<i>Viburnum opulus</i>	12/12
doublefile viburnum	<i>Viburnum tomentosum 'Chesapeake Shasta'</i>	6-8/4-6
chaste tree	<i>Vitex agnus-castus</i>	9-10/10-12
weigelia	<i>Weigelia florida</i>	6-8/6-8

**Evergreen shrubs.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
glossy abelia	<i>Abelia grandiflora</i>	5-7/4-6
kurume azalea	<i>Azalea obtusum</i>	3-6/3-6
wintergreen barberry	<i>Berberis julianae</i>	3-6/2-5
American boxwood	<i>Buxus sempervirens</i>	8-12/8-12
Japanese camellia	<i>Camellia japonica</i>	10-15/5-7
sasanqua camellia	<i>Camellia sasanqua</i>	10/5-7
winter daphne	<i>Daphne odora</i>	3-4/3-4
Japanese euonymus	<i>Euonymus japonicus</i>	10-15/10
Japanese aralia	<i>Fatsia japonica</i>	8/8-10
gardenia	<i>Gardenia jasminoides</i>	4-6/4-5
Burford holly	<i>Ilex cornuta "Burfordi"</i>	10-12/6-8
Dwarf yaupon holly	<i>Ilex vomitoria nana</i>	3/5
pfitzer juniper	<i>Juniperus chinensis pfitzeriana</i>	3-6/8-12
robusta green juniper	<i>J. chinensis 'Robusta Green'</i>	12-15/6-8
wax ligustrum	<i>Ligustrum japonicum</i>	8-15/6-8
Oregon grape holly	<i>Mahonia aquifolium</i>	3-6/3-6
leather leaf mahonia	<i>Mahonia beali</i>	12/3-4
southern wax myrtle	<i>Myrica cerifera</i>	12/15
nandina	<i>Nandina domestica</i>	3-7/2-5
Japanese andromeda	<i>Pieris japonica</i>	6-9/4-6
mugo pine	<i>Pinus mugo</i>	3-5/2-4
pittosporum	<i>Pittosporum tobira</i>	7-9/6-9
English laurel	<i>Prunus laurocerasus 'Otto Luykens'</i>	3-4/4-6
pyracantha	<i>Pyracantha coccinea</i>	6-10/6-10
Indian hawthorn	<i>Raphiolepis indica</i>	3-5/4-5
fragrant viburnum	<i>Viburnum odoratissimum</i>	10-15/8
leatherleaf viburnum	<i>Viburnum rhytidophyllum</i>	10/8-10

**Deciduous Groundcovers.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
maidenhair fern	<i>Adiantum pedatum</i>	1.5/ind
silver mound	<i>Artemisia schmidtiana</i>	1/2
astilbe	<i>Astilbe x arendsii</i>	2/2
lady fern	<i>Athyrium filix-femina</i>	2/2
hardy begonia	<i>Begonia evansiana</i>	1/ind
marsh marigold	<i>Caltha palustris</i>	.8/1
lily of the valley	<i>Convallaria majalis</i>	.8/ind
three-leaved coreopsis	<i>Coreopsis verticillata</i>	1/2
slender deutzia	<i>Deutzia gracilis</i>	2-3/3-4
toothed wood fern	<i>Dryopteris spinulosa</i>	2.5/2.5
daylily hybrids	<i>Hemerocallis species</i>	1.5/ind
hosta	<i>Hosta species</i>	1.5/2
houltuynia	<i>Houttuynia cordata</i>	.6/ind
beacon silver	<i>Lamium maculatum</i>	.5/ind
moneywort	<i>Lysimachia nummularia</i>	.2/ind
creeping mazus	<i>Mazus reptans</i>	.1/ind
mauve catmint	<i>Nepeta mussinii</i>	1.5/ind
sundrops	<i>Oenothera fruticosa</i>	1/1.5
cinnamon fern	<i>Osmunda cinnamomea</i>	3-4/3
shamrock	<i>Oxalis adenophylla</i>	.7/.5
dwarf fleecflower	<i>Polygonum Reynoutria</i>	1.5/ind
bracken fern	<i>Pteridium aquilinum</i>	2.5/ind
stonecrop	<i>Sedum x 'Autumn Joy'</i>	1/2
spreading fern	<i>Thelypteris noveboracensis</i>	1/ind
piggyback plant	<i>Tolmiea menziesii</i>	1/ind
violet	<i>Viola hybrida</i>	.5/1

**Evergreen groundcovers.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
bugleweed	<i>Ajuga reptans</i>	.2/ind
bearberry	<i>Arctostaphylos uva-ursi</i>	.6/10
common thrift	<i>Armeria maritima</i>	.3/.5
cast iron plant	<i>Aspidistra elatior</i>	2.5/2-3
postrate willowleaf cotoneaster	<i>Cotoneaster salicifolius 'Lowfast'</i>	1/4
holly fern	<i>Cyrtomium falcatum</i>	1.5/2.5
cottage pink	<i>Dianthus plumaris</i>	.5/1
leaf lawn	<i>Dicentra micrantha</i>	.2/ind
autumn fern	<i>Dryopteris erythrosora</i>	1.5/2
creeping gardenia	<i>Gardenia radicans</i>	1.5/2.5
coral bells	<i>Heuchera sanguinea</i>	.3/1
Aaron's beard	<i>Hypericum calycinum</i>	1.3/2
candytuft	<i>Iberis sempervirens</i>	.5/1
dwarf yaupon holly	<i>Ilex vomitoria nana</i>	2-3/4-6
shore juniper	<i>Juniperus conferata</i>	1-1.5
creeping juniper	<i>Juniperus horizontalis</i>	1-1.5
dwarf common juniper	<i>Juniperus procumbens nana</i>	.5-1/4-8
liriope	<i>Liriope spicata</i>	1/ind
creeping mahonia	<i>Mahonia repens</i>	2.5/ind
mondo grass	<i>Ophiopogon japonicus</i>	.4/ind
Christmas fern	<i>Polystichum acrostichoides</i>	2/2-3
lavender cotton	<i>Santolina chamaecyparissus</i>	1-2/3-4
Himalaya sweet box	<i>Sarcococca hookerana humilis</i>	1.5/ind
strawberry begonia	<i>Saxifraga stolonifera</i>	.3/ind



Deciduous Vines.

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
trumpet creeper	<i>Campsis radicans</i>	30/15
American bittersweet	<i>Celastrus scandens</i>	25/ind
clematis	<i>Clematis x Jackmannii</i>	15/10
Climbing hydrangea	<i>Hydrangea anomala petiolaris</i>	60/15
Boston Ivy	<i>Parthenocissus tricuspidata</i>	30/ind
Silverlace vine	<i>Polygonum aubertii</i>	25/ind

**Evergreen Vines.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
five-leaf akebia	<i>Akebia quinata</i>	35/ind
cross vine	<i>Bignonia capreolata</i>	50/ind
creeping fig	<i>Ficus pumila</i>	40/10
Carolina jasminum	<i>Gelsimium sempervirens</i>	80/10
lady bank's rose	<i>Rosa banksiae</i>	15/20
greenbrier	<i>Smilax lanceolata</i>	30/ind
star jasmine	<i>Trackelospermum asiaticum</i>	12/15

**Ornamental Grasses.**

COMMON NAME	SCIENTIFIC NAME	AVERAGE HEIGHT/WIDTH
variegated giant reed	<i>Arundo donax versicolor</i>	9/ind
Japanese sedge grass	<i>Carex Morrowii</i> cv. <i>Variegata</i>	1/2
pampas grass	<i>Cortaderia selloana</i>	8/8
umbrella plant	<i>Cyperus alternifolius</i>	5/3
large blue oat grass	<i>Festuca amethystina</i>	1.5/ind
blue fescue	<i>Festuca ovina glauca</i>	.7/1
blue oat grass	<i>Helictotrichon sempervirens</i>	2/3
Japanese blood grass	<i>Imperata cylindrica</i>	1/2
giant maiden grass	<i>Miscanthus floridulus</i>	10/4
maiden grass	<i>Miscanthus sinensis</i> 'Gracillimus'	10/4
variegated maiden grass	<i>Miscanthus sinensis</i> 'Variegatus'	5/6
zebra grass	<i>Miscanthus sinensis</i> 'Zebrinus'	8/10
dwarf fountain grass	<i>Pennisetum alopecuroides hameln</i>	2/2.5
fountain grass	<i>Pennisetum alopecuroides</i>	3/4
ribbon grass	<i>Phalaris arundinacea picta</i>	3/ind
prairie cord grass	<i>Spartina pectinata</i>	4/ind

**Trees to avoid.**

COMMON NAME	SCIENTIFIC NAME	PROBLEMS
box elder	<i>Acer negundo</i>	weak wood, short lived, insects
silver maple	<i>Acer saccharinum</i>	weak wood, insects, shallow roots, prolific seeding
trees of heaven	<i>Ailanthus altissima</i>	offensive odor (male), poor landscape qualities
mimosa	<i>Albizia julibrissin</i>	mimosa wilt disease
European white birch	<i>Betula pendula</i>	insects
paper birch	<i>Betula papyrifera</i>	insects
southern catalpa	<i>Catalpa bignonioides</i>	messy flowers, seed pods
ginko (female plant)	<i>Ginkgo biloba</i>	offensive fruit odor
golden chain tree	<i>Laburnum anagyroides</i>	environmental stress
Chinaberry	<i>Melia azedarach</i>	weak wood, seeds, suckers
mulberries	<i>Morus species</i>	objectionable fruit
empress tree	<i>Paulownia tomentosa</i>	seed pods
Norway spruce	<i>Picea abies</i>	environmental stress (heat, poor drainage)
blue spruce	<i>Picea pungens</i>	environmental stress (heat, poor drainage)
white pine	<i>Pinus strobus</i>	decline & wilt diseases (poor drainage)
scotch pine	<i>Pinus sylvestris</i>	environmental stress (heat, poor drainage, insects)
white or silver poplar	<i>Populus alba</i>	weak wood, diseases
eastern cottonwood	<i>Populus deltoides</i>	weak wood, extensive root system, prolific seeding
lombardy poplar	<i>Populus nigra</i>	extensive root system, short lived, disease
black cherry	<i>Prunus serotina</i>	objectionable, fruit, insects
American elm	<i>Ulmus americana</i>	dutch elm disease
Siberian Elm	<i>Ulmus pumila</i>	short lived, insects

LANGLEY AIR FORCE BASE  
PREFERRED PLANT SPECIES LIST

# LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

SYMBOL	SCIENTIFIC NAME	COMMON NAME	MATURE HT/WD	SPACING O.C.	GROWTH RATE	LIGHT	MOISTURE	TOLERANCE	INTOLERANCE	INTERESTING FEATURES	HISTORIC AREA SPECIES
<b>TALL EVERGREEN TREES</b>											
Apl	<i>Acer platanoides</i>	Norway maple	40-50/30-40	35	Fast	Partial-Full	Moist/Wet		Gypsy moth, drought	Fall color	X
Aru	<i>Acer rubrum</i>	Red maple	50-80/40-50	45	Fast	Partial-Full	Moist/Wet	Water soaked soils	Gypsy moth, drought, and poor pruning	Fall color	X
Coc	<i>Celtis Occidentalis</i>	Common hackberry	30-50/24-40	30	Fast	Partial-Full	Dry/Wet	Poorly drained, drought flood	Lg # insects & diseases	Bark texture	X
Fgr	<i>Fagus Grandifolia</i>	American beech	80-100/50-70	60	Slow	Sun	Dry/Moist				
Fpe	<i>Fraxinus pennsylvanica</i>	Red ash	60/40	35	Fast	Sun	Dry/Wet	Poorly drained, drought, flood, Gypsy moth			
Gbi	<i>Ginkgo biloba</i>	Ginkgo (male)	80/40	35	Slow	Sun	Moist				
Lst	<i>Liquidambar styraciflua</i>	Sweetgum	50-70/40	35	Medium	Sun	Dry/Wet				
Ltu	<i>Liriodendron tulipifera</i>	Tulip poplar	60-100/30-40	35	Medium	Partial-Full	Moist/Wet				
Nsy	<i>Nyssa sylvatica</i>	Black tupelo	70-100/40-60	50	Medium	Partial-Full	Dry/Moist				
Pac	<i>Platanus X acerifolia</i>	London plane tree	80-100/50-70	60	Fast	Partial-Full	Dry/Moist	Wide soil types, shade		Leaf star shape, Fall color	X
Qac	<i>Quercus acutissima</i>	Sawtooth oak	35-40/30-35	33	Moderate	Sun	Dry/Moist			Fan-shaped Leaf	
Qco	<i>Quercus coccinea</i>	Scarlet oak	70/40-50	45	Very Fast	Partial-Full	Dry/Moist			Fall color	
Qmi	<i>Quercus michauxii</i>	Swamp chestnut oak	80/30-40	35	Moderate	Partial-Full	Dry/Moist	Dry, gravelly /sandy, disturbances,	Shade	Fall color	
Qph	<i>Quercus phellos</i>	Willow oak	70/30-40	35	Fast	Partial-Full	Dry/Moist				X

LANGLEY AFB LANDSCAPE DEVELOPMENT STUDY

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LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

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TALL EVERGREEN TREES											
Sba	Salix babylonica	Weeping willow	40/35	35	Moderate	Sun	Moist				X
Sni	Salix nigra	Black willow	30-50/25	25	Moderate	Partial-Full	Moist				
Tas	Taxodium ascendens	Pond cypress	40-50/15-20	20	Moderate	Partial-Full	Moist/Wet				
Tdi	Taxodium distichum	Bald cypress	60-100/30-50	40	Fast	Partial-Full	All				
Tco	Tilia cordata	Linden	30-50/30	30	Moderate	Partial-Full	Moist	Heat	Leaf spot, Gypsy moth	Fragrant flowers	
Upa	Ulmus parvifolia	Chinese elm	60-75/40-50	45	Moderate	Partial-Full	Dry/Wet	Poorly drained soils	Gypsy moth	Bark texture	
Cat	Cedrus atlantica	Atlas cedar	40-60/30-40	35	Moderate	Partial-Full	Dry/Moist		Bagworms	Foliage	
Cde	Cedrus deodara	Deodara cedar	60-100/40-50	45	Fast	Partial-Full	Dry/Moist		Bagworms; Environmental stress (decline)	Foliage	X
Cli	Cedrus libani	Cedar of Lebanon	75/50	50	Moderate	Partial-Full	Dry/Moist				
Cty	Chamaecyparis thyoides	White Cedar	100/40	40	Fast	Sun	Moist/Wet		Bagworms, Gypsy moth		
Cja	Cryptomeria japonica	Cryptomeria	100/25-30	30	Slow	Sun	Moist			Foliage	
Mgr	Magnolia grandiflora	Southern magnolia	80-100/50-80	70	Slow-Moderate	Partial-Full	Dry/Moist		Leaf spot, Borers	Fragrant/showy Flowers	X
Mvi	Magnolia virginiana	Sweetbay Magnolia	60/20-40	30	Moderate	Partial-Full	Moist/Wet		Borers	Fragrant/showy Flowers	
P	Pinus	Japanese Black Pine									
Pni	Pinus nigra	Austrian Pine	80-90/30-40	35	Fast	Partial-Full	Dry/Moist				

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TALL EVERGREEN TREES											
Pta	<i>Pinus taeda</i>	Loblolly Pine	75-100/30-40	35	Fast	Sun	Dry/Wet				
Qvi	<i>Quercus virginiana</i>	Live Oak	40-80/60-100	90	Slow	Partial-Full	Dry/Moist	Heat, drought			X
Toc	<i>Thuja Occidentalis</i>	Arbor vitae	60/30	25	Moderate	Sun	Moist/Wet	Heat, gypsy moth	Bagworm, mites		
SMALL DECIDUOUS TREES											
Apa	<i>Acer palmatum</i>	Japanese Maple	20/20	15	Slow	Partial Shade	Moist			Colorful foliage	
Asa	<i>Acer saccharum</i>	Sugar Maple	10-75/40	20	Fast	Partial-Full	Moist		Gypsy moth, drought, and poor pruning	Fall color	
Aar	<i>Amelanchier arborea</i>	June berry	20-30/12-15	15	Very fast	Partial-Full	Moist			Flower (fragrant, small showy)	
Bni	<i>Betula nigra</i>	River birch	20-40/16-20	20	Fast	Partial-Full	Moist			Bark, Fall color	X
Cch	<i>Cercis chinensis</i>	Chinese redbud	15/10-15	15	Moderate	Partial-Full	Moist			Flowers (bright red)	
Cre	<i>Chionanthus retusus</i>	Chinese fringe tree	15-20/10-15	15	Slow	Partial-Full	Moist/Dry			Flowers	X
Cko	<i>Cornus kousa</i>	Korean dogwood	20/15-18	18	Moderate	Partial-Full	Moist			Fall color, showy flowers	X
Cst	<i>Cornus stolonifera</i>	Red Osier dogwood			Fast	Shade	Moist/Wet	Flooding		Fall color, showy flowers	
Cph	<i>Crataegus phaenopyrum</i>	Washington hawthorn	25-30/20-25	22	Fast	Partial-Full	Moist				
Ffa	<i>Franklinia altamaha</i>	Franklinia	20-30/15-20	18	Slow	Sun	Moist			Fall color, showy fragrant flower	
Hca	<i>Halesia carolina</i>	Carolina silverbell	30/20	15	Moderate	Partial-Full	Moist			Fragrant flower	



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<b>SMALL DECIDUOUS TREES</b>											
Kpa	<i>Koelreuteria paniculata</i>	Golden Raintree	20-30/25-35	30	Slow	Partial-Full	Moist			Fragrant, showy flower	
Lin	<i>Lagerstroemia indica</i>	Crape myrtle	30+/15-20	18	Moderate	Sun	Moist/Wet	Heat		Fragrant flower, Bark	X
Mso	<i>Magnolia saucer</i>	Saucer Magnolia	25/30	25	Moderate	Partial-Full	Moist/Wet			Showy flower	X
Mst	<i>Magnolia stellata</i>	Star Magnolia	15-20/15-20	18	Slow	Sun	Moist/Wet			Showy flower	
Mfl	<i>Malus floribunda</i>	Flowering crabapple	25/25	25	Moderate	Sun	Dry/Moist		Multitude of insect & diseases	Fragrant flowers	X
Oar	<i>Oxydendrum arboreum</i>	Sourwood	20-40/10-15	15	Slow	Partial-Full	Dry/Moist			Showy flower and fruit, Fall color	
Pce	<i>Prunus cerasifera</i>	Purple-leaf plum	15-30/20-25	25	Moderate-Fast	Sun	Moderate			Flowers and foliage color	
Sal	<i>Sassafras albinum</i>	Common Sassafras	40/25	20	Moderate	Partial-Full	Dry/Moist				
<b>SMALL EVERGREEN TREES</b>											
Gla	<i>Fordonia lasianthus</i>	Loblolly bay	30/ 15	15	Moderate	Partial-Full	Moist/Wet	Gypsy moth	Root rot,	Flowers	
Iaq	<i>Ilex aquifolium</i>	English holly	10-20/6-12	10	Slow	Partial-Full	Moist		Mites	Spiny, shower flowers and fruit	
INR	<i>Ilex 'Nellie R. Ste</i>	Nellie R. Steven	15-25/10-15	15	Moderate	Partial- F	Moist			Showy fruit	X
Iop	<i>Ilex opaca 'Fosteri'</i>	Foster's American holly	40/12-20	18	Slow	Partial-Full	Moist			Spiny, showy fruit	X
Ise	<i>Ilex serrata X verticillata</i>	Sparkleberry O holly	15/10-15	15	Moderate	Partial-Full	Moist/Wet				X
Ivo	<i>Ilex vomitoria</i>	Yaupon holly	15-20/5-10	7	Moderate	Partial-Full	Dry/Wet			Fruit	X
Ian	<i>Illicium anisatum</i>	Anise tree	15/8-10	10	Moderate	Partial-Full	Moist		Webworms, Mites	Flowers	

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SMALL EVERGREEN TREES											

Jvi	<i>Juniperus virginiana</i>	Eastern Red Cedar	20-25/8-12	10	Moderate	Sun	Dry/Moist	Heat	Webworms	Foliage	
Ohe	<i>Osmanthus heterophyllus</i>	Holly osmanthus	15-20/12-18	15	Moderate	Partial-Full	Moist			Spiny, fragrant showy flowers.	
Pbo	<i>Persea borbonia</i>	Redbay	60/		Very fast	Partial-Full	Dry/Moist				
Pfr	<i>Photinia fraseri</i>	Red tip photina	20-30/15-20	18	Fast	Partial-Full	Moist	Heat		Foliage	
Pma	<i>Podocarpus macrophylla</i>	Yew podocarpus	30/5-20	15	Slow-Moderate	Partial-Full	Moist	Heat		Foliage	
Pca	<i>Prunus caroliniana</i>	Carolina Cherry Laurel	20-30/15-20	18	Very fast	Partial-Full	Moist/Wet				
Qac	<i>Quercus acuta</i>	Japanese evergreen oak	20-40/8-16	15	Moderate	Sun	Moist			Foliage	
Tor	<i>Thuja orientalis vitae</i>	Oriental arbor	18-25/10-12	12	Fast	Partial-Full	Moist	Heat	Bagworms, mites		

DECIDUOUS SHRUBS

Aca	<i>Azalea calendulaceae</i>	Flame azalea	8-15/5-8	8	Moderate	Partial-Full	Moist		Mites, root rot	Flowers	X
Bth	<i>Berberis thunbergi</i>	Japanese barberry	4	3	Moderate	Partial-Full	Moist	Heat	Mites	Thorns, fragrant, showy flowers	
Bda	<i>Buddleia davidii</i>	Butterfly bush	8-12/6-8	7	Fast	Sun	Dry/Moist		Leaf spot root rot, decline, mildew	Flowers	
Cam	<i>Callicarpa americana</i>	Purple Beautyberry	<9	9	Moderate	Partial-Full	Moist				
Cfl	<i>Calycanthus floridus</i>	Carolina allspice	6-7/5-8	7	Moderate	Partial-Full	Moist		Borers, leaf spot	Fragrant flowers	

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<b>DECIDUOUS SHRUBS</b>											

Coc	<i>Cephalanthus occidentalis</i>	Buttonbush	6-9/5-9	8	Moderate	Sun	Moist/Wet				
Csp	<i>Chaenomeles speciosa</i>	Japanese flowering quince	5-6/5-6	6	Very fast	Partial-Full	Moist			Thorny with showy flowers	
Cal	<i>Clethra alnifolia</i>	Sweet pepperbush	3-10/3-8	6	Moderate	Partial-Full	Moist/Wet		Mildew	Flowers and fruit	
Cpe	<i>Comptonia peregrina</i>	Sweet fern	2-4/2-4	3	Moderate	Sun	Dry/Moist				
Cam	<i>Cornus amomum</i>	Silky dogwood	3-4/7-10	8	Moderate	Shade	Moist/Wet				X
Cam	<i>Corylus americana</i>	American Filbert	3-5/5-9	8	Moderate	Partial-Full	Dry/Moist			Fruit	
Eal	<i>Euonymus alata</i>	Burning bush/Winged Euonymus	8-10/8-10	9	Moderate	Partial-Full	Moist			Fall color	X
Fin	<i>Forsythia intermedia</i>	Forsythia	8-10/10-12	11	Fast	Sun	Dry/Moist			Showy flowers	
Hve	<i>Hamamelis vernalis</i>	Vernal witchhazel	4-6/6-8	7	Fast	Partial-Full	Moist			Showy fragrant flowers and fall color	
Hma	<i>Hydrangea macrophylla</i>	Bigleaf hydrangea	4/4	4	Moderate	Partial-Full	Moist		Leaf spot, mildew	Showy flowers	
Hqu	<i>Hydrangea quercifolia</i>	Oakleaf hydrangea	6-7/6-8	7	Moderate	Partial-Full	Moist		Leaf spot	Showy flowers	
Ide	<i>Ilex decidua</i>	Possumhaw	15-20/10-15	13	Moderate	Partial-Full	Dry/Moist			Edible fruit	
Ive	<i>Ilex verticillata</i>	Winterberry	8-10/5-6	5	Slow	Partial-Full	Moist/Wet	Poorly drained soils		Fruit	

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# LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

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<b>DECIDUOUS SHRUBS</b>											

Jnu	<i>Jasminum nudiflorum</i>	<b>Winter jasmine</b>	2-4/3-5	4	Fast	Partial-Full	Moist	Dry soils		Showy flowers	
Lma	<i>Lonicera maackii</i>	<b>Amur Honeysuckle</b>	10-12/10-12	11	Moderate	Shade Sun	Dry/Moist				
Lta	<i>Lonicera tatarice</i>	<b>Tartarian Honeysuckle</b>	8-10/6-8	8	Fast	Partial-Full	Dry/Moist				
Pco	<i>Philadelphus coronatus</i>	<b>Sweet mockorange</b>	8-10/8-10	9	Fast	Partial-Full	Moist	Borers		Showy fragrant flowers	
Pfr	<i>Potentilla fruticosa</i>	<b>Bush cinquefoil</b>	2-4/3-5	4	Moderate	Partial-Full	Moist	Borers, leaf spot, mildew		Showy flowers	
Rgl	<i>Rhus glabra</i>	<b>Smooth Sumac</b>	8-10/4-6	6	Fast	Sun	Dry/Moist			Showy fragrant flowers, fall color	
Sca	<i>Sambucus canadensis</i>	<b>Elderberry</b>	3-/10-12	11	Moderate	Partial-Full	Dry/Moist	Various soil types and moisture		Showy fragrant flowers, colorful berries and fall color	
Spr	<i>Spirea prunifolia</i>	<b>Double bridal wreath</b>	4-6/5-8	7	Fast	Sun	Moist	Webworms		Flowers	
Sth	<i>Spirea thunbergi</i>	<b>Baby's breath</b>	3-5/3-5	5	Fast	Partial-Full	Moist	Webworms		Flowers	
Vco	<i>Vaccinium corymbosum</i>	<b>Highbush Blueberry</b>	10-12/10-12	11	Slow	Sun	Moist/Wet			Fruit	
Vca	<i>Viburnum carlesi</i>	<b>Fragrant viburnum</b>	6-8/4-6	6	Moderate	Partial-Full	Moist			Fruit and flowers	
Vop	<i>Viburnum opulus</i>	<b>European highbush cranberry</b>	10-12/10-12	12	Fast	Partial-Full	Moist	Borers		Flowers	
Van	<i>Vitex angustifolia</i>	<b>Chaste tree</b>	9-10/10-12	11	Fast	Partial-Full	Dry/Moist	Mildew, decline, root rot		Flowers	

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SYMBOL	SCIENTIFIC NAME	COMMON NAME	MATURE HT/WD	SPACING O.C.	GROWTH RATE	LIGHT	MOISTURE	TOLERANCE	INTOLERANCE	INTERESTING FEATURES	HISTORIC AREA SPECIES
<b>EVERGREEN SHRUBS</b>											
Agr	<i>Abelia grandiflora</i>	Glossy abelia	5-7/4-6	5	Fast	Partial-Full	Moist		Mildew, decline, root rot, leaf spot	Flowers	
Aja	<i>Aucuba japonica</i>	Japanese aucuba	4-8/2-4	3	Fast	Partial-Full	Moist			Interesting foliage	
Aob	<i>Azalea obtusum</i>	Kurume azalea	3-6/3-6	5	Moderate	Shade	Moist		Mites, root rot	Showy flowers	X
Bju	<i>Berberis julianae</i>	Wintergreen barberry	3-6/2-5	4	Fast	Partial-Full	Moist	Heat	Mites	Spiny shrub with showy flowers	
Bse	<i>Buxus sempervirens</i>	American boxwood	8-12/8-12	11	Slow-Moderate	Partial-Full	Moist		Mites, root rot, decline	Foliage	
Cja	<i>Camellia japonica</i>	Japanese camellia	10-15/5-7	6	Slow	Partial	Moist		Mites, webworms	Showy flowers	
Csa	<i>Camellia sasanqua</i>	Sasanqua camellia	9-10/5-7	6	Slow	Partial-Full	Moist		Gypsy moth		
Dod	<i>Daphne odora</i>	Winter daphne	3-4/3-4	4	Slow-Moderate	Partial	Moist		Webworms, root rot	Fragrant showy flowers	
Eja	<i>Euonymus japonicus</i>	Japanese euonymus	10-15/9-10	10	Fast	Partial	Dry/Moist		Leaf spot	Showy flowers	
Fja	<i>Fatsia japonica</i>	Japanese aralia	6-8/8-10	9	Moderate	Sun	Moist				
Gja	<i>Gardenia jasminoides</i>	Gardenia	4-6/4-6	5	Moderate	Partial-Full	Moist		Borers, leaf spot	Fragrant showy flowers	
Icr	<i>Ilex crenata</i>	Japanese holly	3-6/3-6	5	Slow-Moderate	Partial-Full	Moist		Mites, decline		
Jch	<i>Juniperus chinensis</i> v. <i>pfitzeriana</i>	Pfitzer juniper	3-6/8-12	10	Fast	Sun	Dry/Moist		Bagworms, mites	Foliage	
Lja	<i>Ligustrum japonicum</i>	Wax ligustrum	8-15/6-8	7	Fast	Partial-Full	Moist		Leaf spot	Showy flowers	
Maq	<i>Mahonia aquifolium</i>	Oregon grape holly	3-6/3-6	5	Moderate	Partial-Full	Moist	Drought	Mites	Flowers and fall color	

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LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

SYMBOL	SCIENTIFIC NAME	COMMON NAME	MATURE HT/WD	SPACING O.C.	GROWTH RATE	LIGHT	MOISTURE	TOLERANCE	INTOLERANCE	INTERESTING FEATURES	HISTORIC AREA SPECIES
<b>EVERGREEN SHRUBS</b>											
Mbe	<i>Mahonia beali</i>	Leather leaf mahonia	10-12/3-4	4	Moderate	Partial-Full	Moist		Tent caterpillars, bagworms	Flowers and fall color	
Mce	<i>Myrica cerifera</i>	Southern wax myrtle	10-12/12-15	13	Moderate	Partial-Full	Dry/Moist				X
Ndo	<i>Nandina domestica</i>	Nandina	3-7/2-5	4	Fast	Partial-Full	Moist	Heat		Fragrant flowers, fall color	
Pja	<i>Pieris japonica</i>	Japanese andromeda	6-9/4-6	5	Slow	Partial-Full	Moist		Webworms, root rot	Showy flowers	
Pto	<i>Pittosporum tobira</i>	Pittosporum	7-9/6-9	8	Moderate	Sun	Moist	Heat	Borers	Showy flowers	
Pco	<i>Pyracantha coccinea</i>	Firethorn	10-15/8-10	10	Fast	Sun	Dry/Moist	Drought			
Rin	<i>Raphiolepis indica</i>	Indian Hawthorne	3-5/4-5	6	Moderate	Partial-Full	Moist				
Rvi	<i>Rhododron viscosum</i>	Swamp Azalea	4-6/3-4	4	Moderate	Shade	Moist			Showy flowers	X
<b>DECIDUOUS GROUNDCOVERS</b>											
Ape	<i>Adiantum Pedatum</i>	Maidenhair fern	1.5/spread	1	Moderate	Shade	Moist/Wet			Foliage	
Asc	<i>Artemisia schmidtiana</i>	Silver mound	<1/2	1	Fast	Partial-Full	Moist			Foliage	
Aca	<i>Asarum canadense</i>	Wild ginger	<1/spread	1	Slow	Shade	Moist			Fragrant roots	
Aar	<i>Astilbe x arendsii</i>	Astible	<2/2	1.5	Moderate	Partial-Full	Moist/Wet		Leaf spot	Flowers	
Afi	<i>Athyrium filiz-femina</i>	Lady fern	<2/2	1.5	Slow	Partial-Full	Moist			Foliage	
Ago	<i>Athyrium goeringianum pictum</i>	Japanese painted fern	<1/1	1	Slow	Partial-Full	Moist			Foliage	

# LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

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<b>DECIDUOUS GROUND COVERS</b>											
Bev	<i>Begonia evansiana</i>	Hardy begonia	<1/s/	1	Moderate	Partial	Dry/Moist		Decline, root rot	Flowers and foliage	
Cpa	<i>Caltha palustris</i>	Marsh marigold	<1/1	1	Moderate	Partial	Wet		Mites	Flowers	
Cma	<i>Convallaria majalis</i>	Lily of the Valley	<1/s/	1	Moderate	Partial-Full	Moist		Borers, root rot	Fragrant flowers	
Cve	<i>Coreopsis verticillata</i>	3-leaved coreopsis	<1/2	1.5	Moderate	Sun	Dry/Moist		Mildew	Flowers	
Dgr	<i>Deutzia gracilis</i>	Slender deutzia	2-3/3-4	3.5	Slow-Moderate	Partial-Full	Dry/Moist		Mites	Flowers	
Dsp	<i>Dryopteris spinulosa</i>	Toothed wood fern	<2.5/2.5	2	Slow	Partial-Full	Moist				
Hsp	<i>Hemerocallis spp.</i>	Daylily hybrids	<1.5/s/	0.5	Fast	Partial-Full	Dry/Moist	Heat	Leaf spot, mildew	Flowers	
Hosp	<i>Hosta spp.</i>	Hosta varieties	<1.5/2	1.5	Moderate	Shade	Moist/Wet		Leaf spot, mildew, decline	Flowers and foliage	
Lma	<i>Lamium maculatum</i>	Beacon silver	<.5/s/	0.5	Fast	Partial-Full	Moist/Wet		Borers, leaf spot	Flowers and foliage	
Mre	<i>Mazus reptans</i>	Creeping mazus	<1/s/	0.5	Fast	Partial-Full	Moist		Borers	Flowers	
Mdi	<i>Mondarda didyma</i>	Beebalm	1-2/s/	1.5	Moderate	Partial	Dry/Moist				
Nmu	<i>Nepeta mussinii</i>	Mauve catmint	<1.5/s/	0.5	Very Fast	Partial-Full	Moist		Leaf spot	Flowers	
Ofr	<i>Oenothera fruticosa</i>	Sundrops	1/1.5	1	Moderate	Partial-Full	Dry/Moist		Leaf spot	Flowers	
Oci	<i>Osmunda cinnamomea</i>	Cinnamon fern	3-4/3-4	2.5	Slow	Partial-Full	Moist/Wet			Fiddlenecks	
Oad	<i>Oxalis adenophylla</i>	Shamrock	.7/1.5	0.5	Slow	Partial-Full	Dry/Moist		Mites, borers, leaf spot, mildew, decline, root rot	Showy flowers	

# LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

SYMBOL	SCIENTIFIC NAME	COMMON NAME	MATURE HT/WD	SPACING O.C.	GROWTH RATE	LIGHT	MOISTURE	TOLERANCE	INTOLERANCE	INTERESTING FEATURES	HISTORIC AREA SPECIES
<b>DECIDUOUS GROUNDCOVERS</b>											
Pre	<i>Polygonum reynoutria</i>	Dwarf fleece flower	1.5/spread	1	Very Fast	Sun	Moist		Root rot	Showy flowers foliage	
Paq	<i>Pteridium aquilinum</i>	Bracken fern	2.5/spread	1	Fast	Partial-Full	Dry/Moist	Short droughts			
Sed	<i>Sedum x 'Autumn Joy'</i>	Stonecrop	1-2	1	Moderate	Sun	Dry/Moist				
Tno	<i>Thelypteris noveboracensis</i>	Spreading fern	1/spread	1	Fast	Partial-Full	Dry/Moist				
Tme	<i>Tolmiea menziesii</i>	Piggyback plant	1/spread	1	Slow	Sun	Moist				
Vsp	<i>Viola spp.</i>	Violets	.5/1	1	Moderate	Partial-Full	Moist		Mites	Showy flowers	

## EVERGREEN GROUNDCOVERS

Are	<i>Ajuga reptans</i>	Bunglee weed	<.2/spread	0.5	Moderate	Partial-Full	Moist		Mites, root rot	Flowers and foliage	
Auv	<i>Arctostaphylos uva-ursi</i>	Bearberry	.5/10	5	Slow	Shade	Moist		Borers	Flowers and fruits	
Ael	<i>Aspidistra elatior</i>	Cast iron plant	2.5/2-3	2.5	Slow	Partial-Full	Moist/Dry				
Csa	<i>Cotoneaster salicifolius</i>	Postrate willowleaf cotoneaster	<1/4	3	Fast	Sun	moist		Mites	Flowers and fruits	
Cfa	<i>Cyrtominum falcatum</i>	Holly fern	1.5/2.5	2	Slow	Shade	Dry/Moist			Foliage	
Dpl	<i>Dianthus plumaris</i>	Cottage pinks	.5/1	1	Moderate	Sun	Dry/Moist		Mites, borers	Fragrant flowers and showy foliage	
Der	<i>Dryopteris erythrosora</i>	Autumn fern	1.5/2	1.5	Slow	Partial-Full	Moist				
Dgo	<i>Dryopteris goldiana</i>	Goldie's Wood fern	<2/spread	1	Moderate	Shade	Moist				

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LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

SYMBOL	SCIENTIFIC NAME	COMMON NAME	MATURE HT/WD	SPACING O.C.	GROWTH RATE	LIGHT	MOISTURE	TOLERANCE	INTOLERANCE	INTERESTING FEATURES	HISTORIC AREA SPECIES
EVERGREEN GROUNDCOVERS											

Dma	<i>Dryopteris marginalis</i>	Marginal Shield fern	<2/ spread	1	Moderate	Shade	Moist				
Gra	<i>Gardenia radicans</i>	Creeping gardenia	1.5/2.5	2	Moderate	Partial-Full	Moist		Leaf spot, mildew	Fragrant flowers and showy foliage	
Has	<i>Heuchera sanquinea</i>	Coral bells	.3/1	0.5	Slow	Partial-Full	Moist		Mites, borers	Showy flowers and foliage	
Ise	<i>Iberis sempervirens</i>	Candytuft	.5/1	0.5	Moderate	Sun	Moist		Mites	Flowers	
Ivo	<i>Ilex vomitoria nana</i>	Dwarf Yaupon holly	2-3/4-6	5	Slow	Sun	Moist/Wet				
Jco	<i>Juniperus conferta</i>	Shore juniper	1-1.5/ spread	1.5	Fast	Sun	Dry/Moist	Heat	Bagworms, mites	Foliage	
Jho	<i>Juniperus horizontalis</i>	Creeping juniper	1-1.5/ spread	1.5	Fast	Sun	Dry/Moist	Heat	Bagworms, mites	Foliage	
Jpr	<i>Juniperus procumbens 'nana'</i>	Dwarf common juniper	.5-1/4-8	6	Slow	Sun	Dry/Moist	Heat	Bagworms	Foliage	
Lmu	<i>Liriope muscari</i>	Liriope, lily turf	1/ spread	1	Moderate	Partial-Full	Dry/Moist	Heat	Mildew, decline, root rot	Flowers	
Mre	<i>Mahonia repens</i>	Creeping mahonia	.9/ spread	0.5	Slow	Partial-Full	Moist		Mites	Fragrant flowers	
Oja	<i>Ophiopogon japonicus</i>	Mondo grass	.4/ spread	0.5	Slow	Partial-Full	Dry/Moist	Heat			
Pte	<i>Pachysandra terminalis</i>	Japanese spurge	.4/ spread	0.5	Moderate	Shade	Moist		Root rot		
Pac	<i>Polystichum acrostichoides</i>	Christmas fern	<2/2-3	2-5	Slow	Partial-Full	Moist				
Pnu	<i>Polystichum munitum</i>	Western Swordfern	<3/ spread	1	Slow	Sun	Moist				

# LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

SYMBOL	SCIENTIFIC NAME	COMMON NAME	MATURE HT/WD	SPACING O.C.	GROWTH RATE	LIGHT	MOISTURE	TOLERANCE	INTOLERANCE	INTERESTING FEATURES	HISTORIC AREA SPECIES
<b>EVERGREEN GROUNDCOVERS</b>											

Sch *Santolina chamaecyparissus* Lavender cotton 1-2/3-4 3.5 Slow Sun Dry Leaf spot Flowers and foliage

Sst *Saxifraga stolonifera* Strawberry begonia .3/spread 1 Fast Shade Dry/Moist Leaf spot, root rot Flowers

Vmi *Vinca minor* Periwinkle .2/spread 1 Fast Shade Dry/Moist Webworms, mites, root rot Flowers

## DECIDUOUS VINES

Cra *Campsis radicans* Trumpet creeper >30/<15 5 Fast Partial-Full Dry/Moist/Heat Showy flowers

Csc *Celastrus scandens* American bittersweet <25/spread 5 Fast Partial-Full Moist Showy fruits

Cvi *Clematis virginiana* Virgin's Bower <10/<10 2 Fast Partial-Full Moist Showy flowers

Cja *Climatis x jacmannii* Clematis <15/<10 2 Fast Partial-Full Moist Showy flowers

Han *Hydrangea anomala petiolaris* Climbing hydrangea <60/15 5 Moderate Partial-Full Moist Interesting bark and showy flowers

Lse *Lonicera sempervirens* Trumpet honeysuckle 50/spread 2 Very fast Partial-Full Dry/Moist/Wet Fragrant flowers

Lhe *Lonicera x heckrottii* Goldflame honeysuckle 50/spread 2 Very fast Partial-Full Dry/Moist/Wet Fragrant flowers

Pqu *Parthenocissus quinquefolia* Virginia creeper <50/15 5 Fast Partial-Full Dry/Moist/Heat Fall color

Pau *Polygonum aubertii* Silverlace vine <25/spread 5 Fast Partial-Full Dry/Moist Decline, root rot Fragrant flowers

LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

SYMBOL	SCIENTIFIC NAME	COMMON NAME	MATURE HT/WD	SPACING O.C.	GROWTH RATE	LIGHT	MOISTURE	TOLERANCE	INTOLERANCE	INTERESTING FEATURES	HISTORIC AREA/ SPECIES
EVERGREEN VINES											
Aqu	<i>Akebia quinata</i>	5-leaf akebia	>35/spread	5	Very fast	Partial Full	Dry/Moist		Mites	Fragrant flowers	
Bca	<i>Bignonia capreolata</i>	Cross vine	>50/spread	5	Fast	Partial-Full	Moist/Wet		Borers	Showy flowers	
Fpu	<i>Ficus pumila</i>	Creeping fig	<40/10	5	Moderate	Partial-Full	Moist				
Gse	<i>Gelsimum sempervirens</i>	Carolina jasmium	<80/10	5	Moderate	Partial-Full	Moist/Wet		Mites	Fragrant showy flowers	
Rba	<i>Rosa banksiae</i>	Lady Bank's rose	10-15/<20	5	Fast	Partial-Full	Moist		Leaf spot	Showy flowers	
Sla	<i>Smilax lanceolata</i>	Greenbrier	<30/spread	5	Very fast	Shade	Moist				
Tas	<i>Trackelo-spermum asiaticum</i>	Star jasmine	10-12/+15	10	Moderate	Shade	Moist		Leaf spot, mildew	Fragrant, showy flowers	
ORNAMENTAL GRASSES											
Aal	<i>Agrostis alba</i>	Redtop	<18	0.5	Fast	Sun	Dry/Moist/Wet	Acid soil			
Abr	<i>Ammophila brevifigulata</i>	American beachgrass	3-4/	0.5	Fast	Sun	Dry/Moist				
Ado	<i>Arundo donax versicolor</i>	Variegated giant reed	>9/spreads	2.5	Moderate	Sun	Dry/Moist	Gypsy moth	Root rot	Showy flowers and foliage	
Cmo	<i>Carex morrowii</i> cv. <i>Variegata</i>	Japanese sedge grass	<1/2	2	Slow	Sun	Dry/Moist			Foliage	
Cse	<i>Cortaderia selloana</i>	Pampas grass	>8/8	10	Moderate	Sun	Dry/Moist		Root rot	Showy flowers and foliage	
Cal	<i>Cyperus alternifolius</i>	Umbrella plant	<5/3	3	Moderate	Partial-Full	Dry/Moist			Foliage	
Fam	<i>Festuca amethystina</i>	Large Blue oat grass	1.5/spread	2	Slow	Sun	Dry/Moist		Leaf spot	Showy flowers and foliage	

# LANGLEY AIR FORCE BASE PREFERRED PLANT SPECIES LIST

SYMBOL	SCIENTIFIC NAME	COMMON NAME	MATURE HT/WD	SPACING O.C.	GROWTH RATE	LIGHT	MOISTURE	TOLERANCE	INTOLERANCE	INTERESTING FEATURES	HISTORIC AREA SPECIES
<b>ORNAMENTAL GRASSES</b>											

Far	<i>Festuca arundinacea</i>	Tall Fescue 'Kentucky 31'			Fast	Partial-Full	Dry/Moist				
Fov	<i>Festuca ovina glauca</i>	Blue fescue	<1/1	1	Slow	Partial-Full	Dry/Moist		Leaf spot	Showy flowers and foliage	
Fru	<i>Festuca rubra</i>	Red Fescue	<1.5		Moderate	Partial-Full	Dry/Moist				
Hse	<i>Helictotrichon sempervirens</i>	Blue oat grass	<2/3	2	Moderate	Sun	Dry/Moist			Foliage	
Icy	<i>Imperta cylindrica</i>	Japanese blood grass	<1/2	2	Moderate	Sun	Moist			Foliage	
Mfl	<i>Miscanthus floridulus</i>	Giant Maiden grass	<10/4	4	Fast	Sun	Dry/Moist	Gypsy moth	Root rot	Flowers	
MsiG	<i>Miscanthus sinensis 'Gracillimus'</i>	Maiden grass	<10/4	4	Fast	Sun	Dry/Moist	Gypsy moth	Root rot	Flowers	
MsiV	<i>Miscanthus sinensis 'Variegatus'</i>	Variegated Maiden grass	<10/4	4	Fast	Sun	Dry/Moist	Gypsy moth	Root rot	Showy flowers and foliage	
MsiZ	<i>Miscanthus sinensis 'Zebrinus'</i>	Zebra Grass	<8/10	5	Fast	Sun	Dry/Moist	Gypsy moth	Root rot	Showy flowers and foliage	
Pvi	<i>Panicum virgatum</i>	Switchgrass	<6/		Moderate	Sun	Dry/Moist				
Pal	<i>Pennisetum alopecuroides</i>	Fountain grass	<3/4	3	Fast	Partial-Full	Dry/Moist/Wet	Gypsy moth	Root rot, decline	Flowers	
Palh	<i>Pennisetum alopecuroides hameln</i>	Dwarf fountain grass	<2/2.5	2	Fast	Sun	Dry/Moist	Gypsy moth	Root rot, decline	Flowers	

LANGLEY AIR FORCE BASE  
SUPPLEMENT TO ACCI 32-1054

## SIGN STANDARDS

**BY ORDER OF THE COMMANDER**

**ACCI 32-1054**

**Headquarters 1st Fighter Wing (ACC)**

**LAFB SUPPLEMENT 1**

**Langley Air Force Base, Virginia 23665 - 2291**

**Civil Engineering**

**EXTERIOR SIGNS  
REVISED VERSION**

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ACCI 32-1054, 15 November 1996, is supplemented as follows. **COMPLIANCE WITH THIS SUPPLEMENT IS MANDATORY.** Send comments and suggested improvements to this supplement on AF Form 847, Recommendation for Change of Publication, through channels to 1 CES/CECP, Langley AFB VA, 23665. This supplement applies to all Langley AFB personnel, the Air National Guard (ANG), and US Air Force Reserve (USAFR).

### SUMMARY OF REVISIONS

This is the first publication of ACCI 32-1054, LAFB Supplement 1.

**Supersedes: Not applicable.**

**Certified by: 1 SPTG/CC (Col Rivers)**

**OPR: 1 CES/CECP (Suzanne P. Allan)**

**Pages: 3/Distribution: F**

**Approved by: 1 FW/CC (Col Dylewski)**

1. International Service Symbols such as those used to pictorially identify concessions like restaurants and gas stations, as well as sports and recreation facilities, will not be used.

1. 1. (Added) The requirements of ACCI 32-1054 shall also apply to all I SVS activities located on non-Air Force owned property such as Bethel Park and the Langley AFB FAMCAMP.

6. 1. (Added) Base entrance signs shall have incorporated into their design appropriately scaled low-maintenance landscaping to enhance the installation's appearance and encourage pride in assigned personnel.

8. 1. 1. (Added) Signs identifying reserved parking spaces are regulated by AFI 31-204 and its supplements, and are herein deemed locally exempt from Manual of Uniform Traffic Control Devices (MUTCD) color requirements.

8.2. 1. (Added) Posts shall be wood 4' x 4' and colored using an opaque brown stain, not paint.

8.3. 1. (Added) All materials with the exception of posts shall be reflective and the ACC design definitive for street name signs shall be used.

9. The standard design for Organization and Building Identification Signs shall be the Wall Mounted Style as described in Section 9.6. Large-scale facilities, such as the Base Supply Center or Base Civil Engineer Complex, may have a Secondary Sign. If a Secondary Sign is used for a customer service facility or large-scale facility, the Wall Mounted Sign as described in Section 9.6 shall be used. All facilities that have been assigned a street address must have the street address number displayed using Wall Mounted lettering. This Street Address Sign shall be considered a Secondary Sign in terms of size and will consist of the street address number posted directly adjacent to the primary sign. If a facility has no street address, the facility number shall not be posted.

**ACCI 32-1054**  
**LAFB SUPPLEMENT 1**

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9. 1. Wall Mounted Signs consisting of individual letters shall adhere to the standards set forth in AFP 32-1097, Chapter 10, entitled Wall Mounted Signs.

9.2. Wall Mounted Signs as described in Section 9.6 shall be used for Community Facilities Signs.

9.5. 1. (Added) Historical buildings at Langley AFB are defined as those that are listed or eligible for listing on the National Register of Historic Places. An inventory of affected facilities is available through the Base Cultural Resources Manager, 1 CES/CECP. Attaching Wall Mounted, Organization, or Building Identification signs to these buildings will be by exception only. Because of their scale, historic aircraft maintenance hangars may be identified using a painted sign placed at the eave. Buildings will otherwise be identified by using pressure sensitive "crystal" etched letters on entrance glass which may include a unit emblem in addition to the unit name. Display of the street address is mandatory, preferably as part of the entrance glass sign or painted sign, as applicable.

9.6. (Added) **Wall Mounted Signs.** Wall Mounted Signs are made up of individual dimensional letters applied directly to the surface of a building wall. Wall Mounted identification signs should be used in place of other styles of freestanding or Organization/Building Identification Signs. Their use shall be carefully reviewed and approved only in those situations where future changes in content can reasonably be determined as unnecessary and where building structure will not be irreparably damaged in terms of weather resistance and/or aesthetics. Wall Mounted Signs using invasive mountings that will likely compromise certain types of facility exterior finishes, i.e., nails or screws, will not be used. Instead, an adhesive mount will be used.

,9.7. (Added) **Unit Emblems.** A single Unit Emblem may be displayed by Operations Group units at the unit headquarters/command section only. The group and ACC emblem may be displayed at group headquarters facilities. The wing and ACC emblem may be displayed at the wing headquarters facility. In all cases, Unit Emblems will be considered Secondary Signs and in terms of size and style, will follow the guidelines set forth in AFP 32-1097, Chapter 10, entitled Wall Mounted Signs. All existing nonconforming unit emblems on non-headquarters buildings shall be removed.

11. 1. (Added) **Building Dedication Signs.** Buildings collectively referred to by a building dedication name and bearing signage that carries that name should generally be limited to dormitories, auditoriums, and other places of assembly or special historical significance. Such dedications are regulated through AFI 36-3108 Memorialization Program and Ceremonies. If only the building dedication name is displayed, it should follow the guidelines for Wall Mounted Signs. If both the building dedication name and Organization/Building Identification Name are displayed, the building dedication name shall be treated as a Secondary Sign.

12. (Added) **Approval Process.** Requests for new and replacement signs of any type shall be processed using an AF Form 332 and are subject to approval as set forth in this supplement. For new signs associated with a newly constructed facility, an AF Form 332 is not required; however, approval of the sign(s) is subject to review and approval as set forth in this Supplement. At a minimum, all requests shall include information on proposed sign content, existing signs on or associated with the building, and a drawing that illustrates the proposed location, size, and font of the new signage.

12. 1. (Added) **Replacement Signs.** Replacement signs shall meet the criteria contained in this Supplement and are subject to review by the 1 CES Work Request Review Board and approval by 1 SPTG/CC or his delegated authority.

12.2. (Added) **New Traffic Control Signs.** New Traffic Control Signs shall be subject to review by the Base Traffic Safety Committee and approval by 1 FW/CC.

12.3. (Added) **New Directional, Organization, Wall Mounted, Building Identification, Service/Commercial Activity, and Administrative Office Signs.** New signs of this type are subject to review by the 1 CES Work Request Review Board and approval by 1 SPTG/CC or his delegated authority.

12.4. (Added) **New Street and Street Address Signs.** In addition to 1 CES Work Request Review Board approval, new Street Signs must be consistent with the Official Base Map, known as the Base Comprehensive Plan Map C-1

**ACCI 32-1054**  
**LAFB SUPPLEMENT 1****3**

and maintained by 1 CES/CECN. New Street Address Signs shall be reviewed by the 1 CES Work Request Review Board and approved by the 1 SPTG/CC or his delegated authority.

12.5 (Added) **Historical Buildings.** In addition to 1 CES Work Request Review Board review, Historical Building Signs are also subject to review and approval by the Base Cultural Resources Manager, 1 CES/CECP, and the 1 SPTG/CC or his delegated authority.

12.6. (Added) **Water/POL Tank Decals/Signs.** Paint schemes for water and POL Tanks, which incorporate the use of decals or other signs, are subject to review by the 1 CES Work Request Review Board and approval by 1 SPTG/CC or his delegated authority.

13. (Added) **Appeals.** Appeals to decisions made by the Approval Authorities described herein will be forwarded to the 1 FW/CC for final disposition. Appeals will be processed by 1 CES and shall contain information regarding the requestor's proposal, its rationale, and the reasons the request was denied or changed by the original Approval Authority.



# PROJECT PERSONNEL

## PROJECT PERSONNEL

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LO/CR Facility  
Langley AFB, Virginia

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LO/CR Facility  
Langley AFB, Virginia

## APPENDIX DD

### Permitting Requirements

**PERMITTING REQUIREMENTS**

The Design-Build Contractor shall be responsible for preparing the environmental and construction permit applications as listed below. The Design-Build Contractor shall provide all required information and supporting documentation in the appropriate forms and shall submit each form to the applicable agency. Should the permitting agency require additional clarification or information during the permit review process, the Design-Build Contractor shall provide all necessary assistance to resolve any outstanding issue.

<b>Permit Name/Type</b>	<b>Responsible Agency</b>	<b>Responsible Party for Application</b>	<b>Responsible Party Signature</b>
Environmental Assessment	Not Applicable		
Air Pollution Source Construction Permit	Langley AFB	D-B Contractor	D-B Contractor
Title V Operating Permit Modification	?		
Stormwater Construction Permit	Langley AFB	D-B Contractor	D-B Contractor
Stormwater Pollution Prevention Plan	Virginia Department of Conservation & Recreation	D-B Contractor	D-B Contractor
Sanitary Sewer Connection Permit	Langley AFB	D-B Contractor	D-B Contractor
Water Connection Permit	Langley AFB	D-B Contractor	D-B Contractor
Crane Permit	Langley AFB	D-B Contractor	D-B Contractor
Land Disturbing Activity Permit	Langley AFB	D-B Contractor	D-B Contractor
Digging Permit	Langley AFB	D-B Contractor	D-B Contractor
Building Permit	Langley AFB	D-B Contractor	D-B Contractor

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Langley AFB, Virginia

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Langley AFB, Virginia

## APPENDIX EE

### Langley Air Force Base Telecommunications Building Cabling System Standards



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# LANGLEY AIR FORCE BASE TELECOMMUNICATIONS BUILDING CABLING SYSTEMS STANDARDS

2 June 2008

**This standard supersedes Langley AFB Premise Wiring Distribution Systems Standard dated prior to 2 June 2008. This standard also supersedes Contract Specifications Section 16710 and Section 27 10 00 dated prior to 2 June 2008.**

**FOREWORD** The Langley Air Force Base (LAFB) Telecommunications Building Cabling System (TBCS) Standard applies to the Military Construction Projects, Civil Engineering Renovation Building Projects, in accordance with Engineering Technical Letter (ETL) 02-12, Unified Facilities Criteria (UFC) 3-580-01, and technical references provided in this standard. The LAFB TBCS Standard will be used for Military Construction and renovation projects and work for other customers where appropriate. Recommended changes with supporting rationale should be sent to 1 CS/SCX for consideration.

The intent of this standard is to:

- (1). Ensure the system is complete and ready for customer occupancy.
- (2). Prevent facility defacement that would occur if communications infrastructure were not integrated into the facility design and acquisition process.
- (3). Comply with technical architectures and basic standards to ensure compatibility, flexibility, and long-term customer support.
- (4). Provide standardization thereby reducing the need and cost of future modifications that would result from changes in facility occupancy or user reorganization.
- (5). Eliminate funding disconnects that result from fragmenting appropriations sources for communications infrastructure acquisition.
- (6). Realize beneficial effects of enhanced maintenance effort and training qualification by providing standardized communications throughout Langley AFB.

## **DISTRIBUTION:**

1<sup>st</sup> Communications Squadron  
1<sup>st</sup> Contracting Squadron  
1<sup>st</sup> Civil Engineering Squadron  
U.S. Army Corps of Engineer

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**PART 1. GENERAL****1.1 REFERENCES**

The most current issue of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

**TELECOMMUNICATIONS INDUSTRIES ASSOCIATION (TIA)**

Telecommunications Industry Association (TIA)  
2500 Wilson Blvd., Suite 300 Arlington, VA 22201  
ph: (703) 907-7700 fx: (703) 907-7727  
<http://www.tiaonline.org/>

TIA-526-7	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
TIA-526-14-A	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – OFSTP-14
TIA/EIA-568-B.1	Commercial Building Telecommunications Cabling Standard Part 1: General Requirements
TIA/EIA-568-B.2	Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components
TIA/EIA-568-B.3	Optical Fiber Cabling Components Standard
TIA-569-B	Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-570-B	Residential Telecommunications Infrastructure Standard
TIA-598-C	Optical Fiber Cable Color Coding
TIA/EIA-606	Administration Standard for Commercial Telecommunications Infrastructure
J-STD-607-A	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
TIA-758-A	Customer-owned Outside Plant Telecommunications Infrastructure Standard
EIA-TSB 67	Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems
EIA-TSB-75	Additional Horizontal Cabling Practices for Open Offices

**INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)**

IHS  
15 Inverness Way East, Englewood, CO 80112  
ph:(800) 854-7179, fax: (303) 397-2740  
Email: [global@ihs.com](mailto:global@ihs.com)  
Website: <http://store.ihs.com>

ICEA S-80-576	Communications Wire and Cable for Wiring of Premises
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**NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)**

NFPA (National Fire Protection Association),  
1 Batterymarch Park Quincy, MA 02269-9101  
ph: (617) 770-3000 fax: (617) 770-0700  
[www.nfpa.org](http://www.nfpa.org)

NFPA 70	National Electrical Code
NFPA 780	Standard for the Installation of Lightning Protection Systems

**MILITARY STANDARD (MIL-STD)**

MIL-STD-188-124B Grounding, Bonding and Shielding

**1.2. ACRONYMS AND ABBREVIATIONS**

ADA	Americans with Disabilities Act
ADN	Area Distribution Node
AFF	Above Finished Floor
AMEP	Architectural, Mechanical, Electrical, and Plumbing
AMP	Ampere
ANSI	American National Standards Institute
AWG	American Wire Gauge
BCES	Base Civil Engineering Squadron
BCSO	Base Communications Systems Officer
BICSI	Building Industry Consulting Service, International, Inc.
BTCS	Building Telecommunications Cabling Systems
CAT	Category
CD-ROM	Compact Disc - Read Only Memory
cm	centimeters
CMP	Communications Plenum Cable
CO	Contracting Officer (USAF)
CS	Communications Squadron
CP	Consolidation Point
dB	Decibel
dB/KM	Decibels per Kilometer
DC	Direct Current
DDC	Direct Digital Controller
EES	Earth Electrode Subsystem
EIA	Electronics Industry Alliance
ELFEXT	Equal Level Far End Crosstalk
EMCS	Emergency Monitoring and Control System
EMT	Electrical Metallic Tubing
F	Fahrenheit
FO	Fiber Optic
FOC	Fiber Optic Cable
ft	Foot or Feet
GE	Grounding Equalizer
HVAC	Heating, Ventilation and Air Conditioning
ICEA	Insulated Cable Engineering Association
IDC	Insulation Displacement Connector
IDF	Intermediate Distribution Frame
ID	Identification
in	Inches

**1.2. ACRONYMS AND ABBREVIATIONS (cont.)**

LAFB	Langley Air Force Base
LAN	Local Area Network
lb/f	pounds per foot
lx	lux
m	Meter
MDF	Main Distribution Frame
MHz	Megahertz
MILCON	Military Construction
mm	millimeter
MUTOA	Multi-User Telecommunication Outlet Assembly
NEC	National Electrical Code
NESC	National Electrical Safety Code
NEXT	Near End Cross Talk
NFPA	National Fire Protection Association, Inc.
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OSP	Outside Plant
PM	Project Manager
PSELFEXT	Power Sum Equal Far End Cross Talk
PSNEXT	Power Sum Near End Cross Talk
RCDD	Registered Communications Distribution Designer
RUS	Rural Utilities Service
SC	Subscriber Connector (Fiber Optic Connector)
SME	Subject Matter Expert (USAF)
ST	Straight Tip (Fiber Optic Connector)
TBB	Telecommunications Bonding Backbone
TEF	Telecommunications Entrance Facility
TGB	Telecommunications Grounding Busbar
TIA	Telecommunications Industry Association
TMGB	Telecommunications Main Grounding Busbar
TR	Telecommunications Room
UL	Underwriters Laboratory, Inc.
USACE	United States Army Corps of Engineers
UTP	Unshielded Twisted Pair
VAC	Volts Alternating Current

**1.3. SYSTEM DESCRIPTION** The premises wiring distribution system shall consist of permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, and work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for terminating and interconnecting to transport telecommunications (eg. telephone) and data (eg. Local Area Network) signals between equipment items in a building. The premises wiring distribution system shall be provided as a complete system, to include complete telecommunication room (TR) with

dedicated climate control and full wire pathway support from entry into TR and wire management system on equipment racks/cabinets. This will also include complete telecommunications grounding/bonding backbone system. The entire premises wiring distribution system shall be provided in accordance with above listed references and specifications outlined in this standard.

1.3.1. (Reserved)

1.3.2. **RELATED REQUIREMENTS - LIST OTHER SECTIONS THAT APPLY TO THIS SECTION WITH ADDITIONS AND MODIFICATIONS SPECIFIED HEREIN.**

1.3.3. Insulated Cable Engineers Association (ICEA) and American National Standards Institute (ANSI) specifications are listed in the references, and can be purchased at <http://global.ihs.com>.

1.4. **QUALIFICATIONS**

1.4.1. **Telecommunications Qualification** All work under this section shall be performed by and all equipment shall be furnished and installed by a certified Telecommunications Contractor, hereafter referred to as the Contractor. The Contractor shall have the following qualifications in the Telecommunications Systems installation. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.4.1.1. The Contractor shall be a firm which is regularly and professionally engaged in the business of the application, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems of like magnitude within the past three years. Submit documentation for a minimum of three and a maximum of five successful telecommunications system installations for the telecommunications contractor.

1.4.1.2. The Contractor shall have all design proposals, shop drawings, and installation plans prepared by a Registered Communications Distribution Designer (RCDD) and certified as compliant with Building Industry Consulting Services International (BICSI) design practices, American National Standards Institute (ANSI), Telecommunications Industry Association (TIA) standards, and the specifications outlined in this standard by.

1.4.1.3. All supervisors and installers shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electrical trade staff (electricians) shall not be used for the installation of the premise wiring distribution system cables and associated hardware unless.

1.4.1.3.1. All supervisors assigned to the installation of this system or any of its components shall have a minimum Level 2 Installer certification from BICSI with a minimum of five (5) years experience in systems of same size and complexity.

1.4.1.3.2. All installers assigned to the installation of this system or any of its components shall have a minimum Level 1 Installer certification from BICSI with a minimum of three (3) years experience in the installation of the specified copper and fiber optic cable (FOC) and their components.

1.4.2. **Minimum Manufacturer Qualifications** The equipment and hardware provided under this contract shall be from manufacturers that have a minimum of three (3) years experience in producing the types of systems and equipment specified.



1.5. **SUBMITTALS** Government approval is required for submittals. The following shall be submitted to the Contracting Officer (USAF) for review and approval by the Base Communications Systems Officer (BCSO). Any and all equipment ordered by the Contractor without the explicitly written approval from the Government is at the Contractor's own risk of compliance with the requirements of this project.

#### 1.5.1. **Data**

1.5.1.1. **Product Data** Provide complete product data on all system equipment, components and cabling, racks/cabinets, patch panels, telecommunications outlets/connector assemblies, outlet boxes, conduit, cable tray, cable supports, equipment support frame, cable management, cross connects, grounding, fiber optic patch panels, etc.

1.5.1.1.1. Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves.

1.5.1.1.2. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted to the CO for concurrence by the BCSO.

1.5.1.2. **Standard Products** Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industry use for two years prior to bid opening. The two-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the two-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless specifically identified by the CO.

1.5.1.2.1. **Alternative Qualifications** Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.1.2.2. **Material and Equipment Manufacturing Date** Products manufactured more than three years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5.1.3. **Spare Parts** Spare parts, tools, and test equipment provided under this contract, along with an inventory of these spare parts, tools, and test equipment, shall be submitted to CO for review and approval by the BCSO. The inventory data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

#### 1.5.2. **Drawings**

1.5.2.1. **Premises Distribution System Shop Drawings** Shop (Installation) Drawings shall be provided for the installed wiring system infrastructure per EIA ANSI/TIA/EIA-606. Submit Shop Drawings a minimum of ANSI D (17-in. x 22-in.) drawing format using a minimum scale of 1/8 inch per foot. Shop drawings shall graphically document the telecommunications infrastructure to be installed. They shall illustrate relevant infrastructure elements and describe the means of installation. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system.

1.5.2.1.1. Drawings shall include vertical riser diagrams, equipment rack details (to include complete wire management support systems in the TRs), elevation drawings of TR wall, outlet face plate details for all outlet configurations, size and types of cables, conduits, and cable trays.

1.5.2.1.2. Drawings shall show proposed layout and anchorage of equipment and appurtenances and equipment relationship to other parts of the work including clearance for maintenance and operation.

1.5.2.1.3. The drawings shall show the location of all cable terminations and location and routing of all backbone cables, vertical riser cables, horizontal cables, elevation drawings of TR wall, outlet face plate details for all outlet configurations, size and types of cables, conduits, and cable trays.

1.5.2.1.4. Drawings shall indicate equipment rack details (to include complete wire management support systems and equipment elevation), proposed layout and anchorage of equipment.

1.5.2.1.5. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2.1.6. Drawings shall show details of other items that must be shown to ensure a coordinated installation. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.5.2.1.7. The Telecommunications Contractor will receive design approval from the CO with concurrence from the BCSO prior to installation.

1.5.2.2. **Telecommunications Drawings** Provide Registered Communications Distribution Designer (RCDD) approved, Telecommunications Drawings in accordance with EIA ANSI/TIA/EIA-606. Detail drawings, size ANSI E (34-in. x 44-in.) drawing format, shall include the identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure. The drawings shall provide details required to prove that the telecommunications infrastructure system shall properly support connectivity from the telecommunications entrance facility and telecommunications equipment room, through the distribution system(s), to the telecommunications work area outlets.

1.5.2.2.1. The Contractor shall provide two copies of completed as-built drawings in hardcopy format and one electronic copy on CD-ROM in Autocad format prior to final acceptance.

1.5.2.2.2. Provide a plastic laminated schematic of the as-installed telecommunications cable system showing cabling, distribution system(s), and telecommunications spaces keyed to floor plans by room number. Mount the laminated schematic in each TR as directed by the Contracting Officer (CO).

1.5.2.2.3. The following drawings shall be provided as required:

1.5.2.2.3.1. **T0 – Campus or Site Plans** - Exterior Pathways and Campus Backbones Shows physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings.

1.5.2.2.3.2. **T1 – Layout of complete building per floor** - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, TRs, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.

1.5.2.2.3.3. **T2 - Serving Zones/Building Area Drawings** - Drop Locations and Cable Identification (ID) shows a building area or serving zone. These drawings show drop locations, TRs, access points and detail call outs for common equipment rooms and other congested areas.

1.5.2.2.3.4. **T3 – Telecommunications Rooms (TRs)** - Plan Views - Tech and architectural, mechanical, electrical, and plumbing (AMEP) /Elevations - Racks and Walls Elevations Detailed look at TR. Drawing

indicates technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevation and backboard elevation. May also be an enlargement of a congested area of a T1 or T2 drawing.

1.5.2.2.3.5. **T4 – Typical Detail Drawings** - Faceplate Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, etc. Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, installation procedures, detail racking, and raceways.

1.5.2.2.3.6. **T5 – Schedules** (spreadsheets) to show information for cut-overs and cable plant management.

### 1.5.3. Instructions

1.5.3.1. **Manufacturer's Recommendations** Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

### 1.5.4. Statements

1.5.4.1. **Test Plan** Provide a complete and detailed test plan for the telecommunications cabling system(s) including a complete list of test equipment for the UTP components and accessories submitted 60 days prior to the proposed test date. The test plans shall define the tests required to ensure that the system meets technical, operational and performance specifications. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

1.5.4.2. **Qualifications** The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein shall be provided. This shall include proof of the minimum qualifications specified herein.

### 1.5.5. Reports

1.5.5.1. **Test Reports** Test reports shall be provided in booklet form with witness signatures verifying execution of tests. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 7 days after completion of testing and prior to final acceptance of the project to the CO for review and approval by the BCSO for Quality Assurance Inspection purposes.

### 1.5.6. Certificates

1.5.6.1. **Premises Distribution System** The Contractor shall have all design proposals, shop drawings, and installation plans certified as compliant with Building Industry Consulting Services International (BICSI) design practices, American National Standards Institute (ANSI), Telecommunications Industry Association (TIA) standards, and the specifications outlined in this standard by a Registered Communications Distribution Designer (RCDD).

1.5.6.2. **Materials and Equipment** Where materials and equipment are specified to conform, be constructed, or tested to meet specific requirements, certification that the items conform to such requirements must be provided. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specification.

1.5.6.3. **Installers** The Contractor shall submit certification to the CO, for review and approval by the BCSO, that all the installers are factory certified to install and test the provided products.

1.6. **DELIVERY AND STORAGE** Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contamination.

1.7. **OPERATION AND MAINTENANCE MANUALS** Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

## 1.8. RECORD KEEPING AND DOCUMENTATION

1.8.1 **Cables** The Contractor shall be responsible for recording and providing, to the CO, all test data within 7 days of system final testing. A record of all installed cable shall be provided in hard copy format per ANSI TIA/EIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility per ANSI TIA/EIA-606. For all FOC, power meter test results shall be provided in a hard copy format. All twisted pair copper cables shall have a disk copy output of the test results with station ID assigned.

1.8.2. **Termination Hardware** A record of all installed patch panels and outlets shall be provided in hard copy format per ANSI TIA/EIA-606. The hardware records shall include only the required data fields per ANSI TIA/EIA-606.

## PART 2 PRODUCTS

2.1. **MATERIALS AND EQUIPMENT** Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

### 2.2. UNSHIELDED TWISTED PAIR CABLE SYSTEM

2.2.1. Use only cable that has passed the Underwriters Laboratory (UL) LAN certification program and is labeled with UL acceptable markings indicating performance level of cable.

2.2.2. Conductors shall be solid untinned copper 24 AWG.

2.2.3. Cable shall be rated Plenum (CMP) per NFPA 70.

2.2.4. Cable shall be label-verified.

#### 2.2.5. Cable Insulation

2.2.5.1. For each individual horizontal cable, the insulation, material used on each pair shall be exactly the same in all physical, electrical, and chemical respects.

2.2.5.2. The use of plenum rated cable is required for both plenum and non-plenum environments.

2.2.5.3. Plenum rated cable shall be type 4x0, where all four pairs are insulated. Type 3x1 and 2x2 are not acceptable.

## **2.2.6. Unshielded Twisted Pair Cables**

**2.2.6.1. Riser/Backbone Cable** Multi-pair voice backbone cable must meet the requirements of Insulated Cable Engineers Association (ICEA) S-80-576 and TIA/EIA-568-B.2 for riser rated unshielded twisted pair cable.

### **2.2.6.2. Horizontal Cable**

**2.2.6.2.1.** Horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-b.1 for horizontal cable. The category for cable, jacks, termination blocks, and patch panels must be the same throughout each circuit and system.

**2.2.6.2.2.** Horizontal cable shall be Category 5e or better unshielded twisted pair (UTP) cable must be installed to each standard 8-pin modular connector provisioned at the outlet.

**2.2.6.2.3.** All horizontal cables to be installed on any particular installation will be from the same manufacturer.

**2.2.6.2.4.** Cable color will be the same throughout the particular facility. The only exception to this will be, if multiple comm. closets are to be installed in a particular facility, these closet distribution cables may be separate colors to differentiate the difference of comm. closet distribution. Recommended colors for distribution cables are white, gray, or blue.

## **2.2.7. Connecting Hardware**

**2.2.7.1.** Hardware shall be in accordance with and EIA ANSI/TIA/EIA-568-b.2.

**2.2.7.2.** Connecting and cross-connecting hardware shall be the same category rating as the cable it serves.

**2.2.7.3.** Connecting and cross-connecting hardware shall be typically provided as type 110 insulation displacement connection termination unless alternative is specified by the BCSO. In some cases, 66-Block style of terminating blocks may be required.

### **2.2.7.4. Telecommunications Outlets**

#### **2.2.7.4.1. Outlet Faceplate**

**2.2.7.4.1.1.** Outlet Faceplates shall be a 4 or 6 port single gang faceplate with screw cover, labels, and a curved, designer appearance. Each faceplate accepts individual connector modules for all copper and (if used) FOC.

**2.2.7.4.1.2.** Standard administrative outlets may, by specific user request, use single gang outlet faceplates in conjunction with a reducing ring. For single gang outlet boxes, use a single gang outlet faceplate with appropriate connector locations and, if required, mounting lugs for wall phones.

**2.2.7.4.1.3.** Outlet Faceplates shall provide a system for attaching and protecting outlet labels. Adhesive labeled are not to be used on outlet faceplates. Outlets shall be labeled according to the LAFB standard labeling scheme (reference figure 1).

**2.2.7.4.1.4.** Outlet Faceplates shall be provided and coincide with the surrounding decor.

#### **2.2.7.4.2. Copper Outlet/Connector**

**2.2.7.4.2.1.** All outlets shall utilize interchangeable connector modules that mount side by side to facilitate moves, adds and changes. Connector modules shall be available to support high performance copper and fiber cabling systems. All outlets shall be manufactured from high impact thermoplastic material with an U.L. flammability rating of 94HB or better.

2.2.7.4.2.2. All connectors must be 8-pin/8-position insulation displacement terminations wired per T568A in accordance with EIA ANSI/TIA/EIA-568-b.1. Category 3 (Cat 3) rated connectors shall not be used.

2.2.7.4.2.3. Outlet/connector and plugs shall be the same category as the cable they terminate and shall meet the requirements of EIA ANSI/TIA/EIA-568-b.2.

2.2.7.4.2.4. Outlet termination shall be type 110 insulation displacement connection.

2.2.7.4.2.5. Outlet/connector and plugs shall be unkeyed.

#### 2.2.7.4.3. **Outlet Types**

2.2.7.4.3.1. Outlet configurations must comply with this standard, TIA/EIA-568-B, and TIA/EIA-569-B.

2.2.7.4.3.2. Outlet assemblies used for administrative facilities and administrative spaces shall consist of modular jacks assembled in a quadra-plex outlet configuration in single gang covers.

2.2.7.4.3.3. The quadra-plex outlet type does not cover all possible user required configurations. Each outlet type shall be depicted and referenced on the shop drawings (reference Fig. 6 for sketches of commonly used outlet types).

2.2.7.4.4. Standard of quality for Telecommunications Outlets shall be Hellermann Tyton or equivalent.

#### 2.2.7.5. **Unshielded Twisted Pair Patch Panels**

2.2.7.5.1. Patch panels shall be category rated for the UTP system being installed, and arranged in rows or columns on 19-in (475 mm) rack mounted panels.

2.2.7.5.2. Provide a maximum panel size of 48 jacks (preferably with jacks grouped in fours if available).

2.2.7.5.3. Patch Panels shall consist of eight-position, unkeyed modular jacks, with rear mounted type 110 insulation displacement connectors (IDC).

2.2.7.5.4. Jack pin/pair configuration shall be T568A per ANSI/TIA/EIA-568-b1.

2.2.7.5.5. Copper cables must not be split between multiple modular connectors.

2.2.7.5.6. Provide a minimum spare capacity of 10%.

2.2.7.5.7. Panels shall be labeled in accordance with LAFB standard labeling scheme, matched to the corresponding work area outlet.

#### 2.2.7.6. **Terminal Blocks**

2.2.7.6.1. Terminal blocks shall be category rated for the UTP system being installed and typically used to terminate backbone cables to equipment racks/cabinets.

2.2.7.6.2. Insulation displacement connectors (IDC) shall terminate 24 AWG solid copper wire as a minimum.

2.2.7.6.3. Terminal Blocks shall be connected in sequential pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

#### 2.2.7.6.4. **Rack Mounted Terminal Blocks**

2.2.7.6.4.1. Terminal blocks shall be rack mounted wire termination units consisting of insulation displacement connectors (IDC) mounted in plastic blocks, frames or housings.

2.2.7.6.4.2. Blocks shall be type 110 IDC that meet the requirements of ANSI/TIA/EIA-568-b.2.

2.2.7.6.4.3. Blocks shall include cable management hardware above and below.

**2.2.7.6.5. Wall Mounted Terminal Blocks**

2.2.7.6.5.1. Terminal blocks shall be wall mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings.

2.2.7.6.5.2. Blocks shall be type 66 split 50 blocks, typically mounted on a telecommunications backboard to allow interface to voice service demarcations.

2.2.7.6.5.3. In certain applications with BSCO approval, type 110 IDC blocks may be used, meeting the requirements of ANSI/TIA/EIA-568-b.2 for the applicable category rating.

**2.2.8. Patch Cables**

2.2.8.1. Patch cables shall be cable assemblies consisting of flexible, twisted pair wire of the same category rating as the system they serve and shall meet the requirements of EIA ANSI/TIA/EIA-568-b.

2.2.8.2 Use only cable that has passed the Underwriters Laboratory (UL) LAN certification program and is labeled with UL acceptable markings indicating performance level of cable.

2.2.8.3. Copper patch cables must be 4-pair, 24 AWG, stranded UTP cable, with 8-pin modular connectors at each end.

2.2.8.4. Patch cables shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568A patch panel jack wiring per EIA ANSI/TIA/EIA-568-b.1.

2.2.8.5. Provide sufficient copper patch cables, of various appropriate lengths, to terminate all copper patch panel appearances.

2.2.8.5.1. Provide blue patch cables for voice service.

2.2.8.5.2. Provide green patch cables for network service.

2.2.8.5.3. Provide 16ft gray station cables to terminate all copper work area outlet locations.

2.2.8.6. Patch cables shall be keyed (non-booted) and factory assembled.

2.2.8.7. Provide blue patch cords, solid conductor with an eight-position plug on at least one end, for analog service connectivity to the rack-mounted punch block.

**2.3. FIBER OPTIC CABLE (FOC) SYSTEM**

2.3.1. **Fiber Optic Cabling** Multimode fiber optic backbone cable shall be run from Main Distribution Frame (MDF) to Intermediate Distribution Frame (IDF) for networking connectivity to government identified demarcation point.

2.3.1.1. Numerical aperture for each fiber shall be a minimum of 0.275.

2.3.1.2. Cable construction shall be tight-buffered type.

2.3.1.3. Maximum attenuation for indoor multi-mode fiber-optic cabling shall meet the ANSI/TIA/EIA-568-B.3 Specifications for 12 strand, 62.5/125 micrometer multimode graded index optical fiber cable.

2.3.1.4. All horizontal fiber optic cable shall be run in Innerduct or shall be have an armor jacket.

2.3.1.5. Use only cable that has passed the Underwriters Laboratory (UL) LAN certification program and is labeled with UL acceptable markings indicating performance level of cable.

2.3.1.6. Cable shall be rated Plenum (OFNP) per NFPA 70.

2.3.1.7. Cable shall be imprinted with fiber count and aggregate length at regular intervals.

2.3.1.8. Individual fibers shall be color coded for identification.

## **2.3.2. Connecting Hardware**

### **2.3.2.1. Fiber Optic (FO) Outlet/connector**

2.3.2.1.1. Terminate all FO work area cables in dual 568SC connectors unless may be substituted as required by the user with approval from the CO and concurrence by the BCSO.

2.3.2.1.2. Provide FO connectors in accordance with the paragraph entitled "Fiber Optic (FO) Terminations" in this standard.

2.3.2.1.3. The default choice for FO outlet/connector must be TIA/EIA "SC" type (568SC), with a maximum insertion loss of .5 db.

2.3.2.1.4. Multimode FO Connectors shall meet performance requirements of EIA ANSI/TIA/EIA-568-b.3. and EIA ANSI/TIA/EIA-526-14A.

2.3.2.1.5. Connectors shall be field installable.

2.3.2.1.6. Connectors shall utilize adhesive for fiber attachment to ferrule.

2.3.2.1.7. Connectors shall terminate fiber sizes as required for service.

### **2.3.2.2. Fiber Optic (FO) Termination**

2.3.2.2.1. Contractor should not use ST style adapters for new construction unless specifically required for interface with existing equipment reused on installations. Check with activity for specific requirements for ST adapters.

2.3.2.2.2. Provide FO adapters and connectors in accordance with TIA/EIA-604.

### **2.3.2.3. Fiber Optic (FO) Patch Panels**

2.3.2.3.1. Patch panels shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection.

2.3.2.3.2. Patch panels shall be 19-in. rack mounted panels unless otherwise specified in by the CO.

2.3.2.3.3. Patch panel connectors and couplers shall be SC type for termination for connectivity in patch panels, with ceramic ferrule material with a maximum insertion loss of .5 db.

2.3.2.3.4. Patch panel connectors and couplers must be the same type and configuration as used elsewhere in the system.

2.3.2.3.5. Utilize 568SC duplex connectors on 19-in. (475 mm) rack mounted panels, unless otherwise directed.

2.3.2.3.6. Provide a maximum panel size of 12 SC or 24 ST ports for fiber panels.

### **2.3.2.4. Innerduct**

2.3.2.4.1. Innerduct shall be U.L. Listed, non-metallic corrugated flexible raceway used to protect and route fiber-optic cables in the horizontal cable routes.

2.3.2.4.2. Innerduct shall be plenum rated in accordance with the NPFA 70.



2.3.2.4.3. All couplers and adapters shall be of the same manufacturer as the Innerduct and shall be installed in accordance with manufacturer's specifications.

**2.3.2.5. Fiber Optic (FO) Patch Cables** shall be provided by other unless specified by the CO.

## **2.4. EQUIPMENT RACKS**

### **2.4.1. Floor Mounted Open Frame**

2.4.1.1. Equipment racks must be floor mounted, standard 19-in. (475 mm) aluminum relay racks, uprights shall be 3-in. deep, 1 ¼-in. wide, drilled and tapped #12-24 in a half-inch pattern.

2.4.1.2. Racks shall be provided with a standard top crossmember, and predrilled base plate to allow floor fastening.

2.4.1.3. Open frame equipment racks shall be 7-ft in height and clear coated.

2.4.1.4. Wall mounted racks may be utilized in small buildings or for small systems.

### **2.4.2. Wall Mounted Swing Cabinet**

2.4.2.1. Wall Mounted Swing Cabinet shall have smoke-colored plexiglass front door, hinged, with dual key locks.

2.4.2.2. The cabinet main chassis shall be hinged to the back of the enclosure, allowing access to the back of the systems being installed.

2.4.2.3. The cabinet main chassis shall be secured to the back enclosure with dual key locks and a latch system.

2.4.2.4. Both front and rear hinging systems shall be universal allowing the frame to be mounted to open from the left or the right.

2.4.2.5. The cabinet sides shall be vented.

2.4.2.6. The cabinet shall provide standard 19-in. mounting rails, adjustable front to back, drilled and tapped for both #10-32 and #12-24 a half-inch pattern.

2.4.2.7. Cabinet shall be equipped with cooling fans with protective safety covers.

2.4.2.8. Cabinet must be at least 24-in. deep to support equipment dimensions.

2.4.2.9. Cable access ports shall be provided on the top and the bottom of the enclosure with plugs included.

### **2.4.3. Cable Management**

2.4.3.1. Cable management shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on standard 19-inch equipment racks.

2.4.3.2. Cable management shall consist of a type that utilizes duct fingers with snap on, hinged covers.

2.4.3.3. Cable management shall mount to racks by screws and/or nuts and lockwashers.

2.4.3.4. Cable management shall be provided above, below and to both sides of each patch panel on the standard 19-inch equipment rack(s).

2.4.3.5. Vertical cable management will be provided between and to the ends of equipment racks, and provide front and rear vertical cable management.

2.4.3.6. Cable management will be provided in the rear of the rack, utilizing duct fingers with snap on, hinged cover style, or stand-off bars.

2.4.3.7. Velcro ties shall be utilized for binding of horizontal distribution wires within the telecommunications room trays and wire management systems.

**2.5. EQUIPMENT MOUNTING BACKBOARD** A minimum of one wall shall be covered with rigidly fixed ¾-in. (20mm) A-C rated plywood. Plywood backboards shall be void free, 4-ft by 8-ft. Plywood must be fire-rated or painted with gray colored fire resistive paint on all six sides. Anchoring and mounting techniques of plywood used to support backbone riser cables shall be sufficient to support a minimum of 1500 pounds of weight. In no cases shall the heads of mounting screws protrude past the face of the plywood.

**2.6. TELECOMMUNICATIONS OUTLET BOXES** Electrical boxes for telecommunication outlets shall be 4-11/16-in. (119 mm) square by 2-1/8-in. (54 mm) deep with minimum 3/8-in. deep single or two gang plaster ring as shown in provided design drawings. All outlet boxes are to receive Quad jack installation unless otherwise indicated. Provide a minimum 1-in. (27 mm) conduit stubbed above the false ceiling or to the cable tray.

**2.7. TELECOMMUNICATIONS ROOM REQUIREMENTS** TRs shall be designed and provisioned according to the requirements in ANSI/EIA/TIA-569-A.

**2.7.1 Telecommunications Room Sizing** TRs must be an appropriate size to accommodate the proposed cable/LAN distribution system and associated connectivity equipment for any given facility and/or facility floor. The minimum size TR for system installation is 8-ft by 10-ft, avoiding irregular sized TRs, such as narrow rooms or odd shapes. If any additional equipment/racks are placed in a TR, the TR must be enlarged to accommodate.

**2.7.2. Sizing for Tenant Equipment** Provide adequate space in TRs to facilitate tenant owned telecommunications system support equipment requirements in tenant installed freestanding cabinets or racks.

**2.7.3. Clearance and Spacing** A minimum safety clearance distance of 36-in. shall be maintained between wall, or any wall mounted devices, and the equipment to be installed in the communications rack assembly.

**2.7.4. Dedicated Space** TRs must be dedicated spaces not shared with other functions (i.e., electrical rooms, mechanical rooms, etc).

**2.7.5. Environmental Requirements** Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non condensing. The optimal temperature range for each TR shall be 65 - 77 degrees F to support Network accreditation requirements.

**2.7.6. Room Climate Control** Each TR must be independently climate controlled, capable of providing year round ambient temperature control (24 hours/day, 365 days/year) to protect all installed electronic equipment.

2.7.6.1. Dedicated Ventilation Air Conditioning systems support must be provided for each TR.

2.7.6.2. Systems must be of an appropriate capacity to self-support the room, taking into account the heat load of proposed equipment installation requirements.

2.7.6.3. Ventilation Air Conditioning systems must not take up any floor space within the TR.

2.7.6.4. A dedicated 20 Amp circuit for the use of Ventilation Air Conditioning system.

2.7.6.5. TRs must be provided with positive atmospheric pressure to exclude dust.

2.7.7. **Room Interior Finishes** Floors, walls, and ceilings must be treated to eliminate dust. Finishes shall be light in color to enhance room lighting.

2.7.8. **Room Lighting** Light fixtures must be mounted a minimum of 9-ft (3m) above the finished floor and provide a minimum of 50 foot candles (500 lx) of illumination measured 3-ft (1m) above the finished floor. Light fixtures shall be positioned to provide maximum lighting to the room (placing light fixtures directly over cable trays or equipment racks should be avoided because the lighting will be obstructed).

2.7.9. **Room Door** TR doors must be a minimum of 36" (1m) wide, 80" (2m) tall, without doorsill, hinged to open outward into the hallway, or additional room square footage must be added to the floor space to accommodate interior door swing. TR doors must be fitted with a lock to control access to the room. The TR door lock shall be keyed with the standard CES/COMM Maintenance Key (typically known as an MTM key).

2.7.10. **Room Contaminants** Information system equipment must not be installed in spaces where moisture, liquid or gaseous spillage, or other contaminants may be present.

2.7.11. **Power Requirements** Provide a minimum of two dedicated un-switched 20-amp, 120-VAC duplex receptacle power outlets, each on a separate branch circuit, for telecommunication equipment. Increase these minimum requirements as necessary to meet equipment loads. Provide a dedicated 20-amp circuit and a quadraplex receptacle for each 19 in (480 mm) rack or cabinet. Additional convenience receptacles must be provided at 6 ft (1800 mm) intervals around the perimeter walls.

2.7.12. **Telecommunications Outlets** Two (2) Telecommunications Quadra-plex outlets shall be provided in the TR, on the walls parallel to the equipment rack line-up.

## 2.8. Miscellaneous Products

### 2.8.1. Surface Mounted Non Metallic Raceway

2.8.1.1. All surface raceway shall be of a single channel design or dual channel when electrical wiring is run in the raceway. Raceway shall be manufactured from impact-resistant material, or metallic, with a flammability rating of U.L. 94V-0.

2.8.1.2. Contractor is to match color as close as possible the aesthetics of the office environment of the installation site. Raceway finish shall be pure color and will resist scratches and dents and will not peel or corrode. Contractor must receive approval from the CO prior to installation of surface raceway.

2.8.1.3. All surface raceway shall have a full compliment of bend radius control and standard fittings including, but not limited to: elbows (internal & external), couplings for joining raceway sections, blank end fittings for closing open ends of the raceway, and tee fittings.

2.8.1.4. All surface raceway shall incorporate a minimum 1" bend radius as recommended for Category 6 UTP & fiber optic cables.

2.8.1.5. Contractor must prove that other components such as surface boxes, faceplates, etc. are of the same manufacturer and compatible with the surface raceway provided.

2.8.1.6. Standard of quality shall be Hellermann Tyton or equivalent.

2.8.2. **Tele/Power (Utility) Pole** Provide a Tele/Power Pole System to extend communication cabling to points of use to support systems furniture. Tele/Power Pole System shall consist of pole multi-outlet assemblies, and appropriate fittings and accessories as required for a complete assembly.

2.8.2.1. The Tele/Power Pole must be constructed specifically for use with the systems furniture.

2.8.2.2. If electrical service is to be shared in the Tele/Power Pole, a dual compartment with a metallic barrier separating telecommunications cables from electrical cables must be provided in accordance with NFPA 70.

2.8.2.3. The Tele/Power Pole shall be provided with knockouts for a minimum of two (2) duplex, eight-position, surface-mount jacks

2.8.2.4. Surface mount boxes mounted to power poles are not acceptable.

2.8.2.5. The contractor is required to seek final approval from the CO in conjunction with the BCSO on the selection of a Tele/Power pole type and color.

2.8.3. **Firestop** The contractor shall Fire stop all sleeves and conduit openings after the cable installation is complete in accordance with applicable fire and safety code and manufacturer specifications.

### **PART 3 EXECUTION**

3.1. **INSTALLATION** System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system, from the facility's government provided outside plant demarcation point, shall be provided. Components shall be labeled in accordance with EIA ANSI/TIA/EIA-606 and LAFB standard labeling scheme. Penetrations in fire-rated construction shall be fire stopped in accordance with specifications. Conduits, outlets and raceways shall be installed in accordance with EIA ANSI/TIA/EIA-569-A, Telecommunications Pathways and Spaces. Wiring shall be installed in accordance with EIA ANSI/TIA/EIA-568-b.1, b.2. Wiring, terminal blocks, and outlets shall be marked in accordance with EIA ANSI/TIA/EIA-606. Cables shall not be installed in the same cable tray, utility compartment, or floor trench compartment with AC power cables. Cables not installed in conduit or wireways shall be properly secured, per industry standard, and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation. Cable tray installation shall be provided for complete wire support within the TR, from room entrance to overhead rack area, providing complete cable support, when overhead wire installation methods are utilized.

#### **3.1.1. Horizontal Distribution Cable**

3.1.1.1. Horizontal cable length must be limited to 295-ft (90m) from patch panel termination in the TR to the work area outlet termination in accordance with TIA/EIA-568-B.1. All horizontal wiring must be designed in a star-configuration as defined in TIA/EIA-568-B.1.

3.1.1.1.1. The maximum pulling tensions for 4-pair 24 AWG horizontal UTP cables shall not exceed 25 lbf to avoid stretching the conductors during installation.

3.1.1.1.2. Cable management precautions shall be observed to include the elimination of cable stress as caused by tension in suspended cable runs and tightly cinched cable bundles.

3.1.1.1.3. Cable shall not be stressed such that twisting, stretching or kinking of cable during installation.

Cable shall not be spliced.

3.1.1.1.4. Cables shall be installed in conduit, cable trays, or other industry approved hanger assemblies as EIA ANSI/TIA/EIA-568-b.2 recommends.

3.1.1.1.5. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

3.1.1.1.6. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12-in. shall be maintained when such placement cannot be avoided.

3.1.1.1.7. Minimum bending radius shall not be exceeded during installation or once installed.

3.1.1.1.8. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.

3.1.1.1.9. Cable and conductors shall sweep into termination areas.

3.1.1.1.10. Cable and conductors shall not bend at right angles.

#### 3.1.1.2. **Horizontal Distribution Cable Termination**

3.1.1.2.1. The amount of untwisting in a pair as a result of termination to connecting hardware shall not exceed 0.5-in. for UTP cables from IDC.

3.1.1.2.2. An additional practice that shall be followed to reduce untwisting of pairs, is to strip back only as much cable jacket as required to terminate on connecting hardware.

3.1.1.2.3. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

3.1.1.2.4. Also, in spaces with UTP terminations, cable bend radii shall not be less than four times the cable diameter for horizontal cable and shall not be less than ten times the cable diameter for multi-pair cable.

3.1.1.3. **Raised Floors** Cable 6-ft long shall be neatly coiled in a figure-eight configuration not less than 12-in. in diameter below each feed point in raised floor areas, if applicable.

#### 3.1.1.4. **Horizontal Distribution Maintenance Loop**

3.1.1.4.1. Maintenance loop or slack required for modification or re-termination of horizontal cabling shall be no less than 10-ft (3m), at the distribution closet and no less than 24-in. (30cm) at the outlet.

3.1.1.4.2. Maintenance loop shall be provided on the cable tray above the equipment racks in the TR. Slack at the user termination shall not be placed in the outlet box, but shall be installed at the nearest practical point to the outlet box (i.e. above the ceiling prior to entering the wall).

3.1.1.4.3. Slack at the user termination shall be provided in a figure eight configuration.

#### 3.1.2. **Riser and Backbone Cable**

3.1.2.1. Vertical cable support intervals shall be in accordance with manufacturers' recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during and after installation.

3.1.2.2. Maximum tensile strength rating of the cable shall not be exceeded.

3.1.2.3. Cable shall not be spliced.

3.1.2.4. Maintenance loop or slack required for modification or re-termination of backbone cabling shall be no less than 10-ft (3m), at both ends of termination.

3.1.2.5. Provide at least two backbone cable pairs for every outlet connected to the TR served by the backbone cable.

3.1.2.6. The building backbone must have no more than two hierarchical levels of cross-connects.

3.1.2.7. The copper backbone cable originating in the main TR or main cross connect must be terminated in each TR insulation displacement, wiring blocks mounted on the telecommunications backboard.

3.1.2.8. All backbone wiring must be designed in a star-configuration as defined in TIA/EIA-568-B.1.

### 3.1.3. Telecommunication Outlets

#### 3.1.3.1. Outlet Faceplates

3.1.3.1.1. Faceplates shall be clean and free of paint, marks, or smudges.

3.1.3.1.2. Faceplates shall be installed parallel to the floor and other linear décor and not crooked.

3.1.3.1.3. Use a full (double gang) faceplate for standard administrative outlet locations, with connectors for all copper and (if used) FOC.

3.1.3.1.4. Standard administrative outlets may, by specific user request, use single gang outlet faceplates in conjunction with a reducing ring.

3.1.3.1.5. For single gang outlet boxes, use a single gang outlet faceplate with appropriate connector locations and, if required, mounting lugs for wall phones.

3.1.3.1.6. As a minimum each jack shall be labeled as to its function and a unique number to identify cable link, as per LAFB standard labeling scheme.

#### 3.1.3.2. Outlet Location and Density

3.1.3.2.1. Outlet locations, when placed on a fixed wall, shall be located 18" Above Finished Floor (AFF) or at a height equal to existing electrical outlets in the room, when applicable.

3.1.3.2.2. Outlet densities for all administrative facilities and administrative spaces shall be equipped with one standard telecommunications outlet for each 48 square feet (4.5 square meters) of net office space.

3.1.3.2.3. Outlet densities and locations for all special-purpose spaces and non-administrative facilities must be determined by the user and approved by the CO in conjunction with the BCSO and must follow the guidelines in TIA/EIA-569-B.

3.1.3.2.4. Special consideration shall be given to the placement of outlets to accommodate systems furniture designs.

3.1.3.2.5. When placing outlets in a raised floor setting, jacks shall be placed in recessed floor gang boxes that provide appropriate accessibility and protection of outlets.

3.1.3.3 **Pull Cords** Pull cords shall be installed in all conduits serving telecommunications outlets, which do not initially have FOC installed.

#### 3.1.4. Terminal Blocks

3.1.4.1. Terminal blocks shall be mounted on orderly rows and columns.

3.1.4.2. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks.

3.1.4.3. Terminal Blocks shall include cable management hardware on either side at the corners of the terminal block mounted horizontally and one mounted vertically a few inches below each row of blocks.

3.1.4.4. Wall mounted 66-type terminal blocks shall be utilized at the Main Distribution Frame (MDF) or Demarcation Point for outside plant copper cross connect capability.

3.1.4.5. Rack mounted 110 IDC terminal blocks will be used as the Intermediate Distribution Frame (IDF) point (Patch Panel end) for copper backbone cable cross connects.

3.1.4.6. Cable Management Hardware for wall mounted terminal blocks is usually provided as "D" rings type. Cable Management Hardware shall be sized for the application provided. Wire spools shall not be used for cable distribution systems serving greater than 100-pairs.

### **3.1.5. Patch Panels**

#### **3.1.5.1. Unshielded Twisted Pair Patch Panels**

3.1.5.1.1. Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 25 percent spares for future expansion.

3.1.5.1.2. Cable management will be provided above, below, between, and to both sides of each panel, to include the front and rear of rack, and patch Panel assembly.

#### **3.1.5.2. Fiber Optic (FO) Patch Panels**

3.1.5.2.1. Patch panels shall be mounted in the top of the center equipment rack or cabinet (under the OSP fiber patch panel or with space reserved for the OSP fiber patch panel), with sufficient ports to accommodate the installed cable plant.

3.1.5.2.2. A slack loop of fiber shall be provided within each panel. Loop shall be 3-ft in length or longer if recommended by the manufacturer.

3.1.5.2.3. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.5.2.4. FO Patch Panels providing facility service shall be installed at the top (or sufficient space reserved if provided by other) with backbone FO Patch Panels provided under the OSP FO Patch Panel.

3.1.5.2.5. Each fiber shall be terminated to the Contractor supplied patch panel, using applicable connectors. No fiber will be left un-terminated.

3.1.5.2.6. Panels shall be labeled per LAFB standard labeling scheme.

#### **3.1.5.3. Fiber Optic Cables (FOC)**

3.1.5.3.1. Terminate all FO work area cables in dual 568SC connectors unless may be substituted as required by the user with approval from CO and concurrence from the BCSO.

3.1.5.3.2. All FO backbone cable must be terminated in cabinet/rack-mounted patch panels, at each end.

### **3.1.6. Telecommunications Equipment Racks**

#### **3.1.6.1. Floor Mounted Equipment Racks**

3.1.6.1.1. Open frame equipment racks shall be bolted to the floor.

3.1.6.1.2. Cable management shall be bolted or screwed to racks.

3.1.6.1.3. Racks shall be installed level, and ganged racks shall be bolted together (with cable management mounted in between racks).

3.1.6.1.4. Open frame equipment racks shall be secured per industry standards to prevent racking or swaying.

3.1.6.1.5. AC outlets shall be provided in the equipment rack to prevent tripping, one quad outlet dedicated 20 Amp line assembly, per every two equipment racks provided and labeled with the applicable circuit breaker number.

3.1.6.1.6. Equipment racks shall be located at or near the center of the TR.

3.1.6.1.7. Equipment racks must provide a minimum 36-in. (900 mm) space both in front and in back of the rack, behind any installed equipment, and a minimum side clearance of 24-in. (600 mm) on end racks.

3.1.6.1.8. In smaller TRs, equipment racks may be floor mounted adjacent to a wall.

3.1.6.1.9. Provide 100% spare rack capacity based on the amount of rack capacity utilized by the patch panels provided.

3.1.6.1.10. Spare racks must be provided for the mounting of government purchased and installed LAN equipment.

#### **3.1.6.2. Wall Mounted Equipment Racks**

3.1.6.2.1. Wall mounted, swing out racks shall be provided in special instances where TR floor space does not allow proper safety clearance per NPFA 70.

3.1.6.2.2. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.

3.1.6.2.3. No more than two wall mounted racks shall be installed in the same ganged rack assembly.

3.1.6.2.4. Ganged wall mounted racks shall be hinged to the inside of the ganged racks to allow fully loaded racks to swing open.

3.1.6.2.5. Proper safety clearance must be provided in front of the equipment rack and when the rack is opened for access to the back of the systems with the chassis opened.

#### **3.1.7. Telecommunications Equipment Cabinets**

##### **3.1.7.1. Floor Mounted Equipment Cabinets**

3.1.7.1.1. Equipment cabinets shall be provided in special instances where physical security is required, to mount secure or mission critical equipment, in circumstances where controlled access is desired, distribution in military housing, or by specific user request.

3.1.7.1.2. Cable may be terminated in an enclosed 19-in. (475mm) cabinet to provide enhanced protection for terminations and patching facilities.

3.1.7.1.3. Cabinets must provide, at a minimum, sufficient space for current and anticipated future equipment requirements.

3.1.7.1.4. Equipment cabinets may be floor or wall mounted and should be logically grouped based on the purpose of the equipment they enclose.

3.1.7.1.5. Cooling fans must be provided in all equipment cabinets.

3.1.7.1.6. Cabinets shall be installed level, and ganged cabinets shall have adjacent side panels removed.

3.1.7.1.7. Equipment Cabinets shall be secured per industry standards.

3.1.7.1.8. Proper safety clearance must be provided in front and back of the equipment cabinet.



### 3.1.7.2. Wall Mounted Equipment Cabinets

3.1.7.2.1. Wall mounted, swing out cabinets shall be provided in small applications and special instances where TR floor space does not allow proper safety clearance per NPFA 70.

3.1.7.2.2. Wall mounted cabinets shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.

3.1.7.2.3. Wall mounted cabinets shall be mounted to manufacture specifications and industry standards.

3.1.7.2.4. Proper safety clearance must be provided in front of the equipment cabinet and when the cabinet is opened for access to the back of the systems with the chassis in opened.

3.1.7.2.5. The cabinet height shall be sized to support premise wiring distribution system requirements with 25% spare capacity.

3.1.7.2.6. AC outlets shall be provided in the cabinet to provide power for equipment, one quad outlet dedicated 20 Amp line assembly, per every cabinet provided.

3.1.8. **Rack Mounted Equipment** Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturers recommended fasteners.

3.1.9 **Building infrastructure** In new construction, particularly in large administrative or medical facility buildings, cable distribution systems must use the cable tray (or duct) and conduit systems as described. In new construction involving small, mixed use (non administrative) facilities, or construction projects involving renovation of existing buildings, use of "J" hooks, flexible cable tray, and alternative support systems specifically certified for horizontal cable is permissible.

#### 3.1.9.1. Ladder and Wire Cable Tray

3.1.9.1.1. Ladder type or welded wire cable tray must be used in the TR to provide distribution between the telephone backboard, equipment racks, backbone conduits, and the distribution cable tray.

3.1.9.1.2. Cable trays shall be designed to accommodate a maximum calculated fill ratio of 50% to a maximum inside depth of 6 in (150 mm).

3.1.9.1.3. Provide 12-in. of clearance above cable trays for future access.

3.1.9.1.4. Coordination with other disciplines must take place to insure proper clearances are provided.

#### 3.1.9.2. Conduit

3.1.9.2.1. Electrical Metallic Tubing (EMT) Conduit for standard outlets must be a minimum of 1-in. (27mm) EMT conduit.

3.1.9.2.2. No more than four, four-pair cables may be in a 1-in. (27mm) conduit.

3.1.9.2.3. Conduit bend radii must be coordinated with cable bend radius.

3.1.9.2.4. Conduit entries at outlet and junction boxes must be arranged so that cables passing through the box must enter and exit at opposite sides of the box.

3.1.9.2.5. An optimal conduit fill ratio of 40% should be accommodated for conduit. Under no circumstances should the designer exceed a fill ratio of 50%.

3.1.9.2.6. Do not use metal flex conduit for telecommunications wiring except when installing floor-access boxes in a raised floor, where floor-access box must be relocated within a specified service area: i.e., 15-20 foot radius typical.

**3.1.9.3. Pull Boxes**

3.1.9.3.1. Pull boxes must be placed in conduit runs where a continuous conduit length exceeds 100-ft, or where there are more than two 90-degree bends.

3.1.9.3.2. Pull boxes must be placed in straight runs of conduit and not be used in lieu of a bend.

**3.1.9.4. Raceway**

3.1.9.4.1. Surface mounted non-metallic raceway may be used in renovation projects where access to the walls for installation of conduit and outlet boxes is not possible, or where historical requirements prohibit the alteration of the building structure.

3.1.9.4.2. Securely install all surface raceway by using proper installation screws into walls. Screws shall be within 2-in. of the top and bottom of each end and shall have mounting screws at 18-in. intervals.

3.1.9.5. Innerduct installed shall include pre-installed pull tape.

**3.2. TERMINATIONS** All cables shall be neatly "dressed out" in equipment rooms. Cable and conductors shall sweep into termination areas. Cable and conductors shall not bend at right angles. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel. Also, in spaces with UTP terminations, cable bend radii shall not be less than four times the cable diameter for horizontal cable and shall not be less than ten times the cable diameter for multi-pair cable.

**3.2.1. Unshielded Twisted Pair Cable**

3.2.1.1. Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels.

3.2.1.2. No cable shall be un-terminated or contain un-terminated elements.

3.2.1.3. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA ANSI/TIA/EIA-568-b.2.

3.2.1.4. An additional practice that shall be followed to reduce untwisting of pairs, is to strip back only as much cable jacket as required to terminate on connecting hardware.

3.2.1.5. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

**3.2.2 Fiber Optic Cable (FOC)** Each fiber shall be terminated to the Contractor supplied patch panel, using applicable connectors. No fiber will be left un-terminated.

**3.2.3. Open Office Wiring****3.2.3.1. Systems Furniture Wiring**

3.2.3.1.1. Systems furniture wiring connections must be designed in accordance with TIA/EIA-568-B and TIA/EIA-569-B.

3.2.3.1.2. Systems furniture wiring designed must be approved by the CO and concurrence from the BCSO.

3.2.3.1.3. Systems Furniture must provide a dedicated channel/pathways for routing communications cables.

3.2.3.1.4. Systems Furniture communications channels must provide easy access to install and maintain communications cables.

3.2.3.1.5. Communications cable must be protected at all transition points, and that metallic separation is provided between telecommunication and power wiring in the power pole and/or systems furniture track in accordance with TIA/EIA-569-B 10.3 and Article 800-52 of NFPA 70.

3.2.3.1.6. Direct connection, from the TR patch panel to the communications outlet in the systems furniture, must not be used.

3.2.3.1.7. Use, to the maximum extent possible, communications outlets installed on premanent structures, such as walls or pillars, to provide communications service to systems furniture.

3.2.3.1.8. A minimum of two communications outlets per single occupancy systems furniture cubicle must be provided. However, additional outlets must be provided to accomadate network printers, fax machines, copiers, secure telephones, and other specialized systems/devices. As a general rule, provide a ratio of 2.25 communications outlet capacity per single occupancy systems furniture cubicle to support these specialized systems/devices when the exact quantity or location is not provided.

3.2.3.1.9. Use tele/power poles or similar assemblies to provide communications service to systems furniture which can not be serviced, or is impractical to service, from communications outlets provided on a permanent structure.

### 3.2.3.3. **Communications (Utility) Pole**

3.2.3.3.1. The Communications pole must be constructed specifically for use with the systems furniture being installed or provided and shall be equivalent in size, structure, materials, and color as existing poles.

3.2.3.3.2. Communications poles shall be secured to the floor and ceiling per manufacture standards and provide the ability to be relocated at a later date.

3.2.3.3.3. Provide 10ft of slack as a maintenance loop coiled in a figure-eight and secured above the ceiling over the communications pole.

3.2.3.3.4. Provide knockouts for a minimum of two (2) duplex, eight-position, surface-mount jacks. Surface mount boxes mounted to power poles are not acceptable.

3.2.3.4. **Multi-User Telecommunication Outlet Assembly (MUTOA)** MUTOAs may be provided in an open office environment that is planned to be frequently reconfigured so that each furniture cluster is served by at least one MUTOA. MUTOAs may be provided in an open work area MUTOA application and design must follow the guidance of TIA/EIA-568-B.1.

3.2.3.4.1. MUTOAs shall be located in fully accessible, permanent locations such as building columns, and permanent walls. MUTOAs shall not be located in ceiling spaces, or obstructed areas. MUTOAs shall not be installed in furniture unless that unit of furniture is permanently secured to the building structure.

3.2.3.4.2. The MUTOA must be limited to serving a maximum of twelve (12) users. Measurements for Systems Furniture must take into account the dimensions of the MUTOAs planned to be provided in a given open office environment. Spare capacity should be considered when sizing the MUTOA.

3.2.3.4.3. Do not exceed the horizontal cable length requirements. The maximum lengths for copper cabling in the context of MUTOAs and open office furniture, shall meet the requirements of ANSI/TIA/EIA-568-B-2.

3.2.3.5. **Consolidation Point (CP)** CPs may be provided in an open office environment where it would be most advantageous to utilize an interconnection point within the horizontal cabling. CPs should be located in an open work area so that each furniture cluster is served by at least one CP.

3.2.3.5.1. CPs shall be located in fully accessible, permanent locations such as building columns, and permanent walls. CPs shall not be located in ceiling spaces, or obstructed areas. CPs shall not be installed in furniture unless that unit of furniture is permanently secured to the building structure.

3.2.3.5.2. CPs shall be provided in accordance with TIA/EIA-568-B.2 or TIA/EIA-568-B.3 utilizing compliant connecting hardware rated for at least 200 cycles of reconnection.

3.2.3.5.3. No more than one consolidation point shall be used in the same horizontal cable run. A transition point and consolidation point shall not be used in the same horizontal-cabling link.

3.2.3.5.4. The CP must be limited to serving a maximum of twelve (12) work areas. Do not exceed the horizontal cable length requirements. Spare capacity should be considered when sizing the CP.

3.2.3.6. **Utility Rooms and Closets** All utility rooms and closets, such as electrical, mechanical and telecommunications, must be wired with at least one wall mounted telecommunications outlet, with a mounting lug face plate.

3.2.3.7. **Elevators** For buildings with elevators, a four-pair copper cable with an eight-position modular outlet adapter must be installed for each elevator. The exact location of the outlet assembly must be verified with the elevator installer or Contractor.

3.2.3.8. **Safety, Courtesy, & Convenience** Provide wall outlets at all logical locations to support safety, courtesy, & convenience. Examples for safety include: dormitory dayrooms, laundry room; examples for courtesy include: building lobby, entrance, or waiting area; examples for convenience include: break rooms, rear (unmanned) entrances.

3.2.3.9. **Building Automation Systems** Provide wall outlets at specified locations to support building automation systems as identified by Civil Engineering planners. For example, one such outlet may be a direct digital controller (DDC) outlet (or Environmental Management Control System (EMCS)) for the HVAC system.

### 3.3. BONDING AND GROUNDING

3.3.1. **Telecommunications Room Signal Ground** All unclassified TRs must be connected to the building earth electrode subsystem (EES) in accordance with J-STD-607-A.

3.3.1.1. The Telecommunications Main Grounding Busbar (TMGB) shall be tied to the building EES with a two-hole compression lug fittings and at least a #2 AWG Telecommunications Bonding Backbone (TBB).

3.3.1.2. TMGB with stand off insulators shall be tied to the Telecommunications Grounding Busbar (TGB) with a two-hole compression lug fittings and at least a #4 AWG TBB.

3.3.1.3. The size of the grounding electrode conductor of a grounded system shall be at least a #6 AWG TBB and sized in accordance with J-STD-607-A.

3.3.1.4. The signal grounding system shall not interconnect with the fault protection and lightning protection sub-systems within the building.

3.3.1.5. Bonding and grounding system shall be tested per ANSI/TIA/EIA and NFPA 70 standards.

3.3.1.6. Bonding and grounding system shall be labeled per ANSI/TIA/EIA and LAFB standard labeling scheme.

3.3.1.7. All telecommunications racks and supporting structures (cable trays, ladders, conduits and baskets) within a TR must be bonded to the TGB or TMGB as defined in J-STD-607-A.

### **3.3.2. Telecommunications Rack and Supporting Structure**

3.3.2.1. All telecommunications racks and supporting structures (cable trays, ladders, conduits and baskets) within a TR must be bonded to the TR signal ground ring or bus bar as defined in and TIA/EIA-569-B (TGB or TMGB as defined in J-STD-607-A).

3.3.2.2. The Equipment Racks shall be bonded together using Compression Lugs and green-jacketed 6 AWG Stranded Copper.

3.3.2.3. Equipment racks shall be connected to the electrical safety ground only if a separate earth ground is not available.

3.3.2.4. Deviations to these standards shall be submitted to the CO for review and approval by the BCSO.

### **3.3.3. Cable Entrance Grounding**

3.3.3.1. All metallic shields and strength members for outside plant cable entering a building must be connected to the lightning protection ground system.

3.3.3.2. The designer must ensure that the lightning protection is in accordance with MIL-STD-188-124B and NFPA 780, Standard for the Installation of Lightning Protection Systems, latest issue.

**3.4. ADDITIONAL MATERIALS** The Contractor shall provide the following additional materials, required for facility startup, to the BCSO:

3.4.1. One(1) set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

3.4.2. Patch cords as defined in paragraph entitled "Patch Cables" in Part 2 of this standard.

3.4.3. Any materials or parts left over at the end of the project or turned over as part of the complete system shall be identified to the CO in the form of a complete inventory and provided to the BCSO with approval from the CO.

### **3.5. ADMINISTRATION AND LABELING**

#### **3.5.1. Labeling**

3.5.1.1. All telecommunications systems labeling shall be done in accordance with LAFB standard labeling scheme provided as a technical exhibit to this specification (reference figure 1 of this standard) and TIA/EIA-606-A.

3.5.1.2. All outlets and patch panel positions must be labeled as to their function and with a unique identifier code.

3.5.1.3. All devices, outlet locations, and designations must also appear on the system drawings.

3.5.1.4. Labeling must be a minimum of 1/4-in. (6mm) high.

3.5.1.5. Handwritten labels must not be used for the final configuration.

#### **3.5.2. Outlet/Connector Markings**

3.5.2.1. As a minimum each jack shall be labeled as to its function and a unique number to identify cable link, as per LAFB standard labeling scheme.

3.5.2.2. Each communications outlet must have a unique identifying number in accordance with TIA/EIA 606-A.

3.5.2.3. In the TR, this unique identifying number must be associated with the position on the patch panel or cross-connect to which the outlet is connected.

3.5.2.4. Each horizontal cable must be labeled both at the outlet and patch panel or cross-connect position in the communications closet.

### 3.5.3. Telecommunications Patch Panel Labeling

3.5.3.1. Patch panel labeling must be done in accordance with TIA/EIA 606. Each position must be labeled with a unique designator corresponding to the outlet location.

3.5.3.2. FO port labeling must be done in accordance with TIA/EIA 606. The left or top connection should be labeled "A." The right or bottom connection should be labeled "B."

3.5.3.3. Color-coding in accordance with TIA/EIA-606-A may be added to the labeling.

### 3.5.4. Distribution System Labeling

3.5.4.1. The distribution system is described in TIA/EIA-606-A for pathways.

3.5.4.2. All transitions and changes in distribution system size and type must be labeled.

3.5.4.3. Each cabinet must be labeled at the top with a unique designation.

## 3.6. COMMUNICATION CABLING INSPECTION AND TESTING

### 3.6.1. Inspection

3.6.1.1. System inspection shall be provided through performance of pre-installation, in-progress and final inspections by the CO in conjunction with the BCSO (or authorized representative), at intervals provided below. Contractor is responsible to notify the CO and BCSO when installation has reached the below installation phases:

3.6.1.1.1. **(35 Percent)** will primarily consist of communication closet set-up, pathways and spaces, and cable support.

3.6.1.1.2. **(50 Percent)** will consist of cable handling and pulling techniques, adherence to industry standards, and code compliance.

3.6.1.1.3. **(75 Percent)** consists of termination techniques, review of testing procedures and test plan, and documentation.

3.6.1.1.3.1. Each item of installed equipment shall be checked to insure appropriate UL certification markings.

3.6.1.1.3.2. This inspection shall verify cabling terminations in TRs and at workstations adhere to color code for proper pin assignments and cabling connections are in compliance with ANSI/EIA/TIA standards.

3.6.1.1.3.3. Visually confirm proper cable category marking of cabling, outlets/connectors and patch cords.

3.6.1.1.3.4. There will be no 100% inspection until all areas up to the 75% inspection have been completed and the inspectors have reviewed testing documentation.

3.6.1.1.4. **(100 Percent)** Acceptance Inspection consists of documentation, final testing and test data, discrepancy review, operability testing, and final acceptance. This inspection shall verify that the equipment provided adheres to the installation requirements of this document. The interim inspection

will be conducted by a factory-certified representative and witnessed by a Government Representative Subject Matter Expert (SME) appointed by the BCSO and approved by the CO.

3.6.1.2. The Contractor shall notify the CO, in writing, of the estimated date the Contractor expects to be ready for the interim inspection, at least 20 working days before the requested inspection date.

3.6.1.3 The Contractor and/or the SME, shall perform in progress inspections, which shall include visual inspections of equipment condition, wiring, splicing, cabling, mounting and placement of equipment, miscellaneous hardware, and adherence to safety procedures. These inspections shall ensure compliance with the specified installation criteria.

3.6.1.4. The Contractor shall perform FO field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests to the CO. All FOCs shall be tested on the reels prior to installation. Remove failed cable reels from project site upon attenuation test failure.

3.6.1.4. Results of any inspection shall be provided to the CO and PM. If major or multiple deficiencies are discovered, a second interim inspection may be required before permitting the Contractor to continue with the system installation. The CO and/or the PM shall determine if an additional inspection is required, or if the Contractor will be allowed to proceed with the installation. In either case, re-inspection of the deficiencies noted during the interim inspection(s), will be part of the proof of performance test. The interim inspection shall not affect the Systems' completion date. The CO shall provide all test documents to the BCSO to become a part of the Systems record documentation.

3.6.1.6. The Contractor shall conduct a final inspection that encompasses all phases of the installed project. This inspection shall be conducted to verify all phases of the contract have been completed according to the specifications and that proper installation practices have been followed.

3.6.1.7. The Contractor shall provide, as part of the final inspection, a review of the as-installed telecommunications drawings (otherwise known as "as-built drawings") to the CO to be reviewed and approved by the BCSO upon completion of the installation. The SME and/or CO will participate in and witness the final inspection of the communication cabling system.

**3.6.2 CABLE TESTING** The Contractor shall perform the cable tests and provide complete detailed reports of all tests, for all cables and components, specified as follows and as herein:

**3.6.2.1. Acceptance Test** The Contractor shall schedule an acceptance test date and give the CO 30 days written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a Government Representative and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance. The test shall verify that the total System meets the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

**3.6.2.2. Copper Backbone Verification Tests**

3.6.2.2.1. UTP Backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield if cable has overall shield.

3.6.2.2.2. Backbone wiring must be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective TRs.

3.6.2.2.3. Test operation of shorting bars in connection blocks.

3.6.2.2.4. Test cables after termination but not cross-connected.

**3.6.2.3. Fiber Backbone Verification Tests**

3.6.2.3.1. For multimode FOC, perform optical fiber end-to-end attenuation tests at the 850 nm and 1300 nm windows in both directions, in accordance with TIA/EIA-568-B.3 and TIA-526-14-A using optical power meter and light source method for multimode FOC. All connectors shall be tested and the loss measured in dB and shall have a loss limit that complies with ANSI/TIA/EIA-526-14A.

3.6.2.3.2. For single-mode FOC, perform optical fiber end-to-end attenuation tests in accordance with TIA/EIA-568-B.3 and TIA-526-7 using optical power meter and light source method for single-mode FOC. All connectors shall be tested and the loss measured in dB and shall have a loss limit that complies with ANSI/TIA/EIA-526-7A.

**3.6.2.4. Performance Testing**

3.6.2.4.1. Perform the applicable Category 5e or greater tests, using the appropriately rated test set, for each outlet in accordance with ANSI/EIA/TIA-568-B.1 and ANSI/EIA/TIA-568-B.2.

3.6.2.4.1.1. Testing shall use the Permanent Link Test procedure of EIA ANSI/TIA/EIA-568-b.2. for all horizontal copper cables.

3.6.2.4.1.2. Additional testing shall be required for MUTOA and CP applications to provide the Channel length is not exceeded.

3.6.2.4.1.3. Test shall include the following: wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.

3.6.2.4.1.4. All installed CAT 5e cable shall be tested for attenuation loss at 100 MHz and results reported in dB.

3.6.2.4.1.5. All installed Cat 6 cable shall be tested for attenuation loss at 250 MHz and results reported in dB.

3.6.2.4.2. FO Links: Perform end-to-end FOC link tests for each outlet in accordance with ANSI/EIA/TIA-568-B.3. All FO links shall be tested and the loss measured in dB/KM.

3.6.2.4.3. FO connectors must be visually inspected for scratches, pits or chips and must be re-terminated if any of these conditions exist. No cost shall be incurred by the government for the replacement of deficient cables.

3.6.2.5. After testing is completed, all circuits shall be restored to their pre-test state (i.e. reconnected, re-terminated, etc.)

3.6.2.6. The Contractor shall ensure that all telecommunications cable, installed as part of a project, be tested to the commercial standards for that cable system. All test results and certifications must be provided in a report upon completion of construction to the CO for review and approval by the BCSO responsible for system O&M.

3.6.2.7. Tests must be performed from both ends of each circuit. End to end testing is defined from the equipment end through the cross connect to the terminal end.

3.6.2.8 All "auto-test" results obtained from the cable tester shall be supplied in both hard copy and on disk to the CO and authorized representative.



3.6.2.9. All telecommunications cable tests shall be completed and all errors corrected before any other tests are started. Cables, which contain failed circuits, shall be replaced and retested to verify the standard is met.

3.6.2.10. **Grounding System** All grounds and bonds shall be tested for continuity according to EIA ANSI/TIA/EIA-607. Resistance to ground testing shall be accomplished on the ground electrode system in accordance with Technical Order 31.10.24, Part two, Chapter 6 and NFPA 70, sections 250-81, 250-83 and 250-86 and must be no less than five (5) Ohms. This standard shall apply to new and existing facilities. Test results shall be reported in hard copy format. The ground shall be labeled or tagged in accordance with EIA/TIA 606.

### 3.7. ACCEPTABILITY

3.7.1. **Tolerance Limits** The Contractor shall be responsible for immediate corrections to the communications cabling systems that shall bring it into full compliance with requirements that are revealed by these inspections. Following correction, a re-examination of previous non-compliant items will be conducted at the discretion of the CO.

3.7.2. **Additional Testing** After installation is complete, in addition to any other required testing, and at such times as the CO or his authorized representative directs, the Contractor shall conduct an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall; be promptly corrected at no cost to the government and the tests re-conducted.

### 3.8. TEST REPORTS

3.8.1. The Contractor shall be responsible for recording and providing to the CO, all test data. Copies of all test results shall be submitted the CO or his authorized representative for review and remain the property of the Government for their records.

3.8.2 For all FOCs, power meter test results shall be provided hard copy and correspond to a labeled FOC.

3.8.3. All twisted pair copper cable shall be provided in hard copy format and as a disk copy output of the test results with the station ID assigned.

3.8.4. All test results shall be provided to the CO prior to Quality Assurance Inspection for acceptance of Premises Wire Distribution System installation.

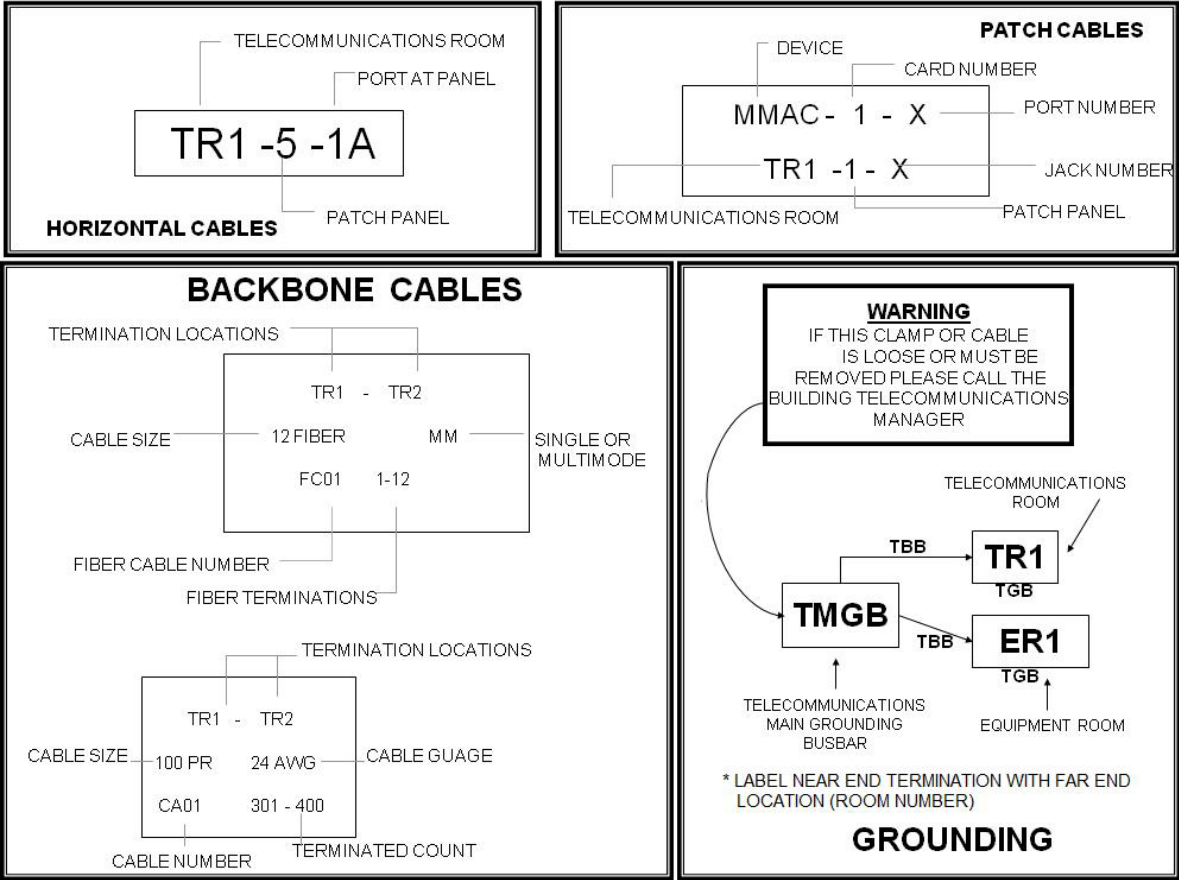


Figure 1 – LAFB Standard Labeling Scheme (sheet 1 of 2)

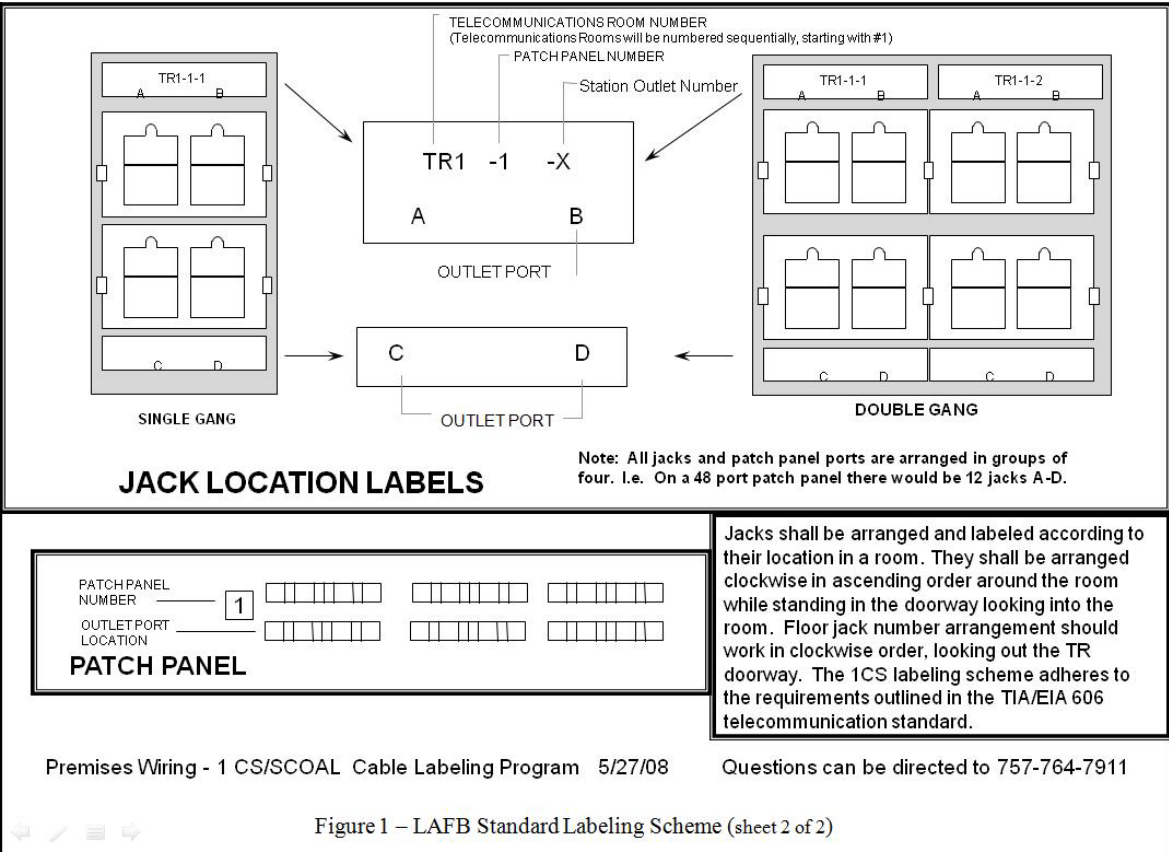


Figure 1 – LAFB Standard Labeling Scheme (sheet 2 of 2)

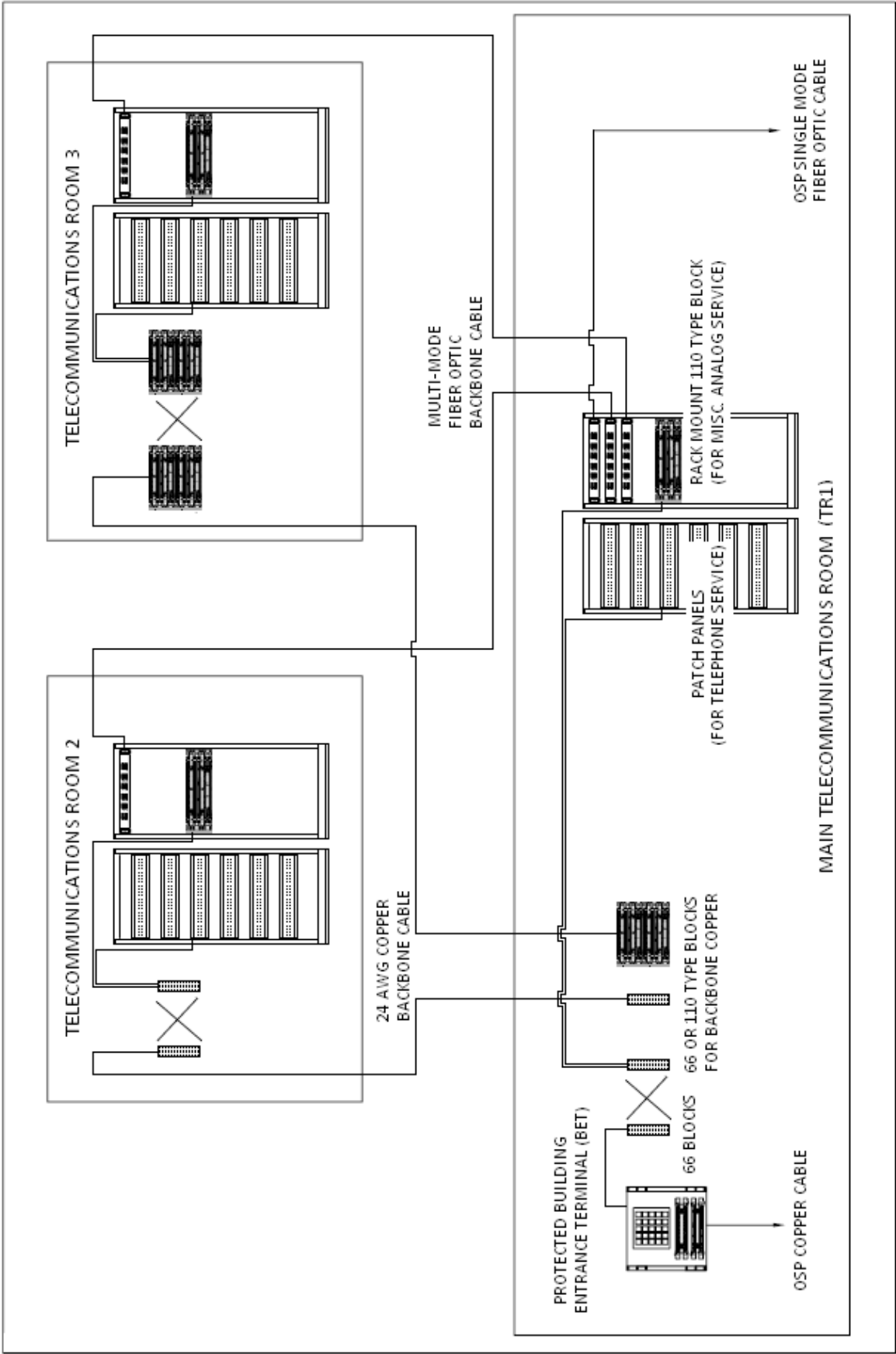


Figure 2 - Typical Telecommunications Room Entrance and Backbone Diagram

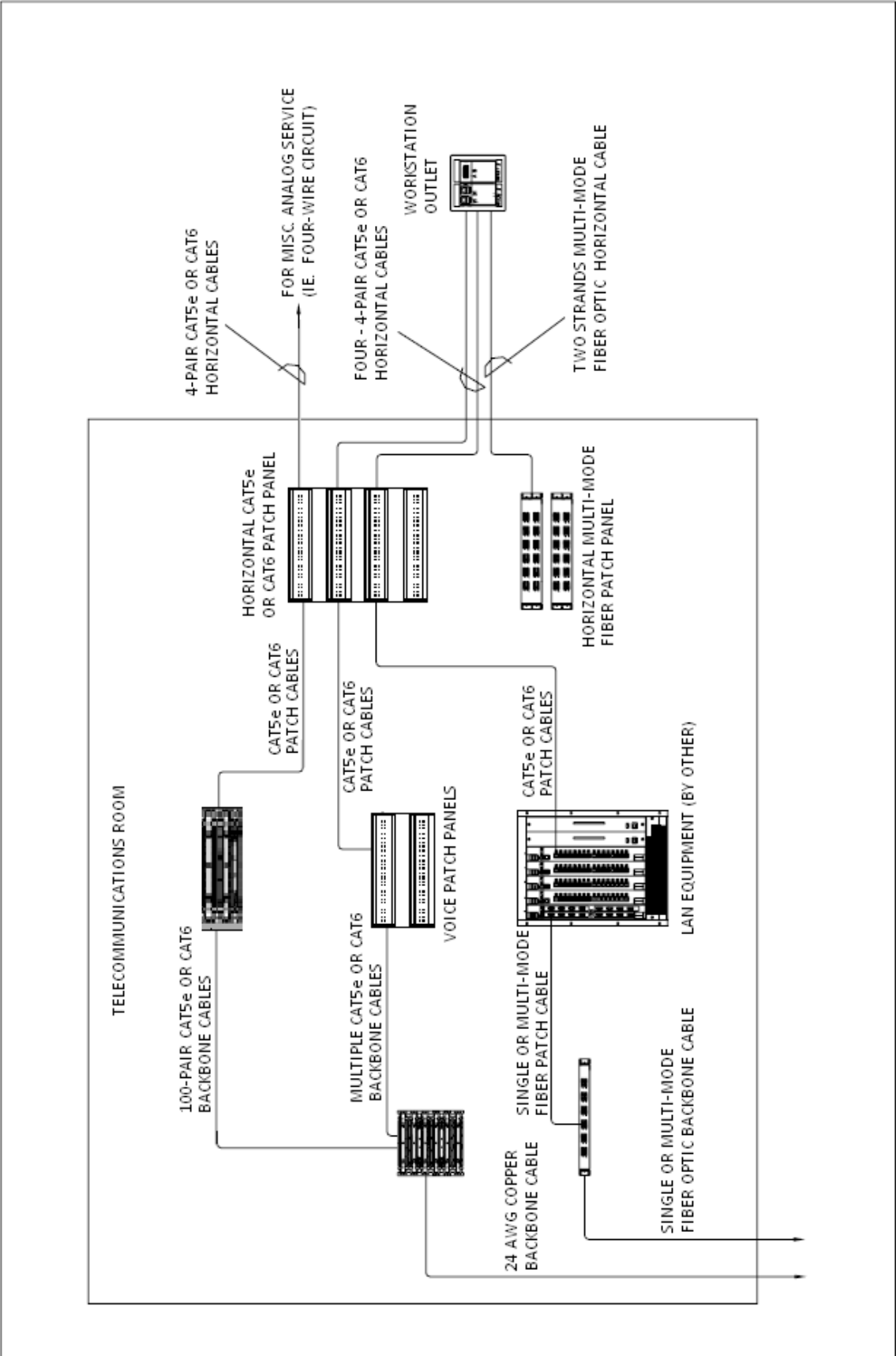


Figure 3 - Typical Telecommunications Room Horizontal Distribution Diagram

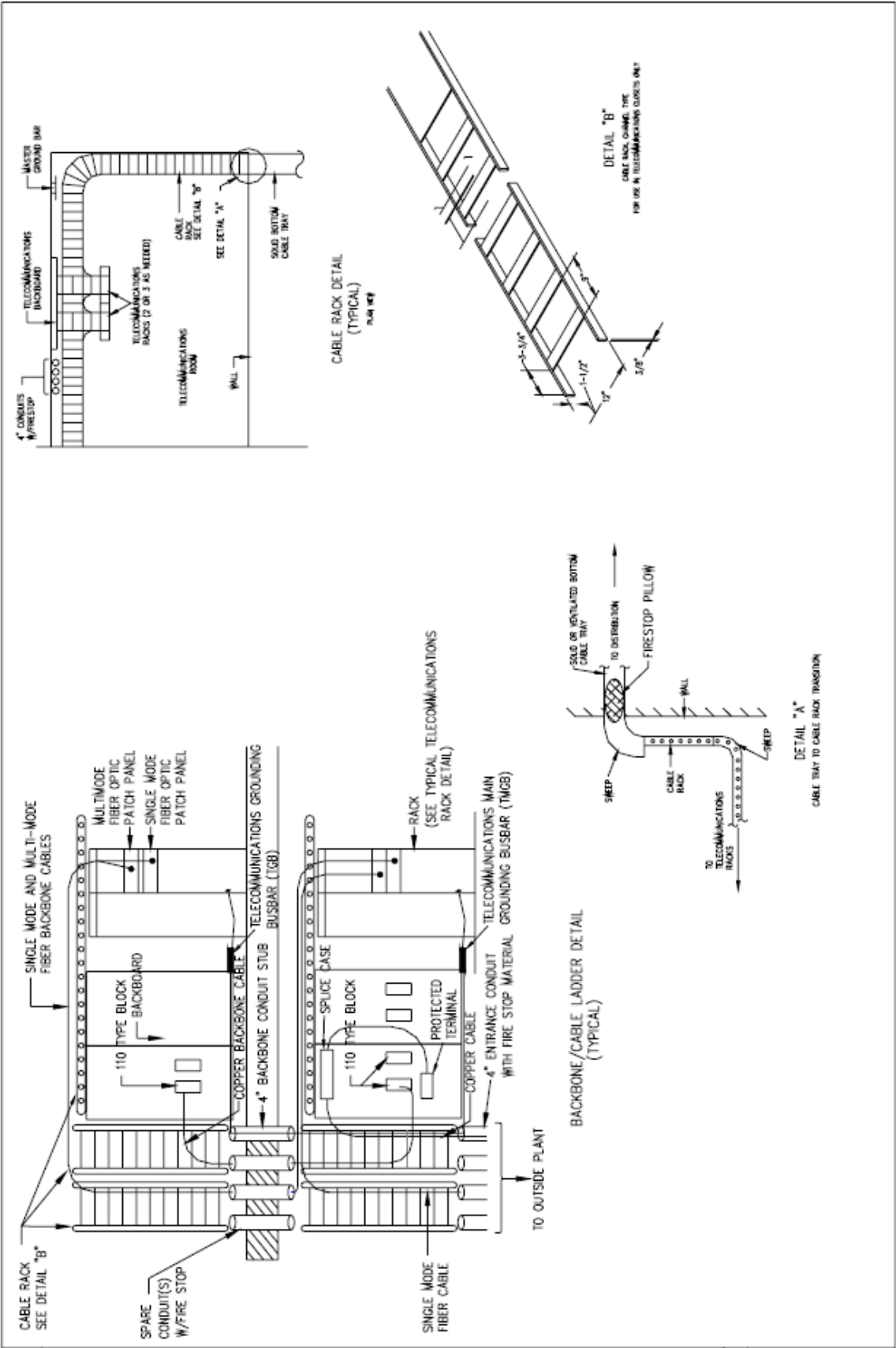
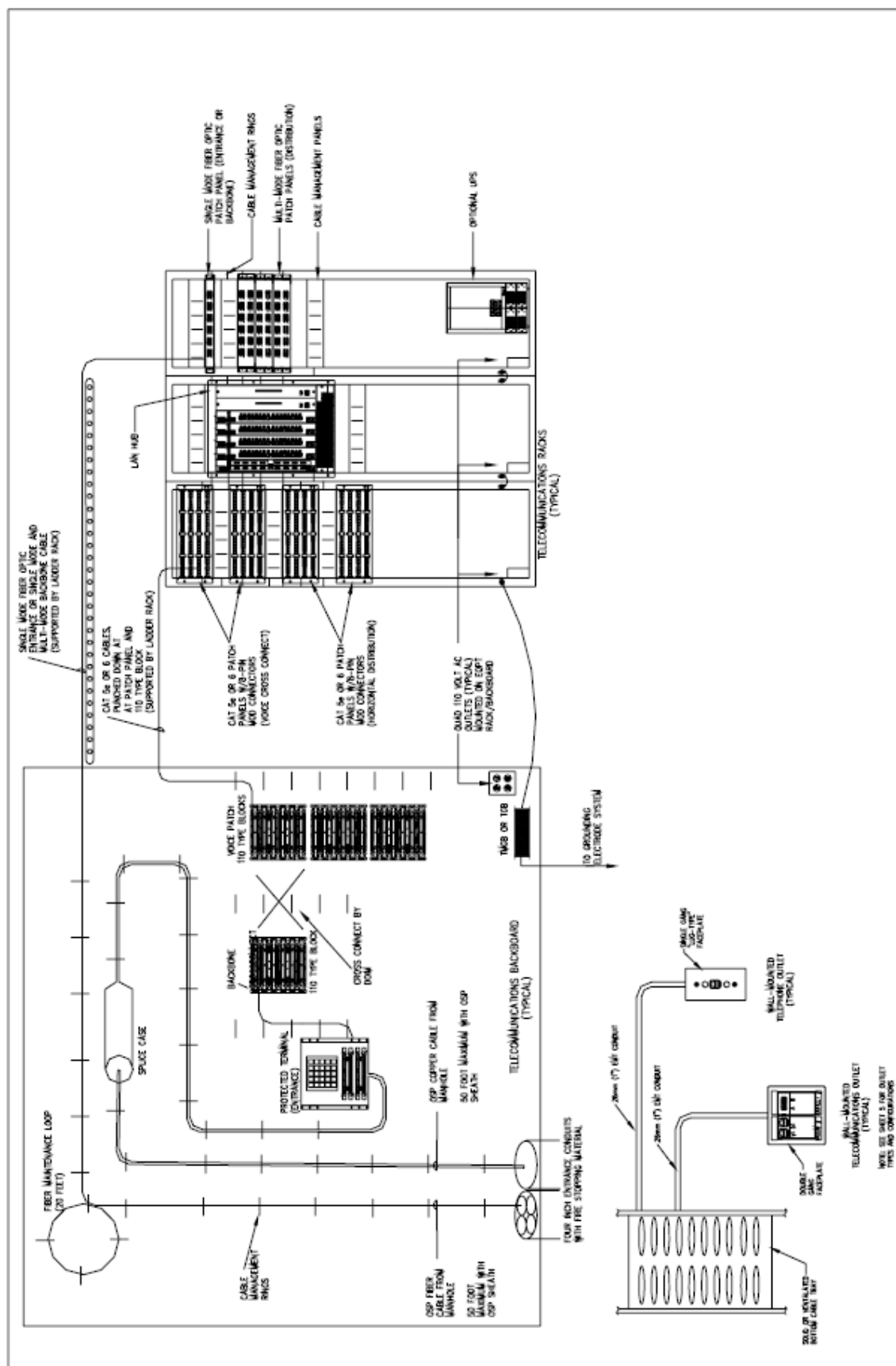
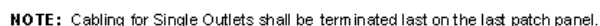


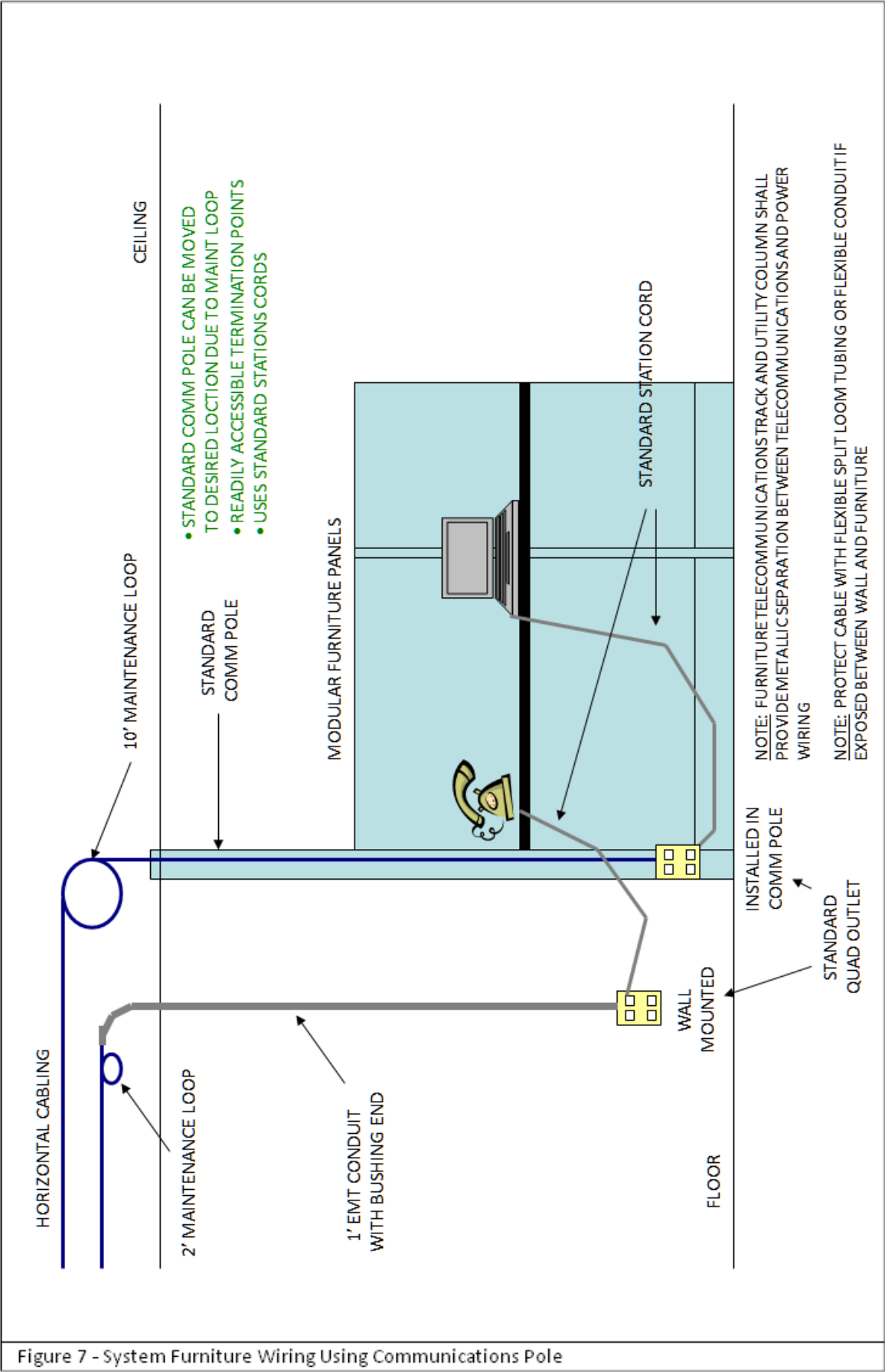
Figure 4 - Typical Telecommunications Room Standard Supporting Structure and Backbone



**Figure 5 - Typical Telecommunications Room Standard Premise Wiring Distribution**



Tuesday, July 13, 2010





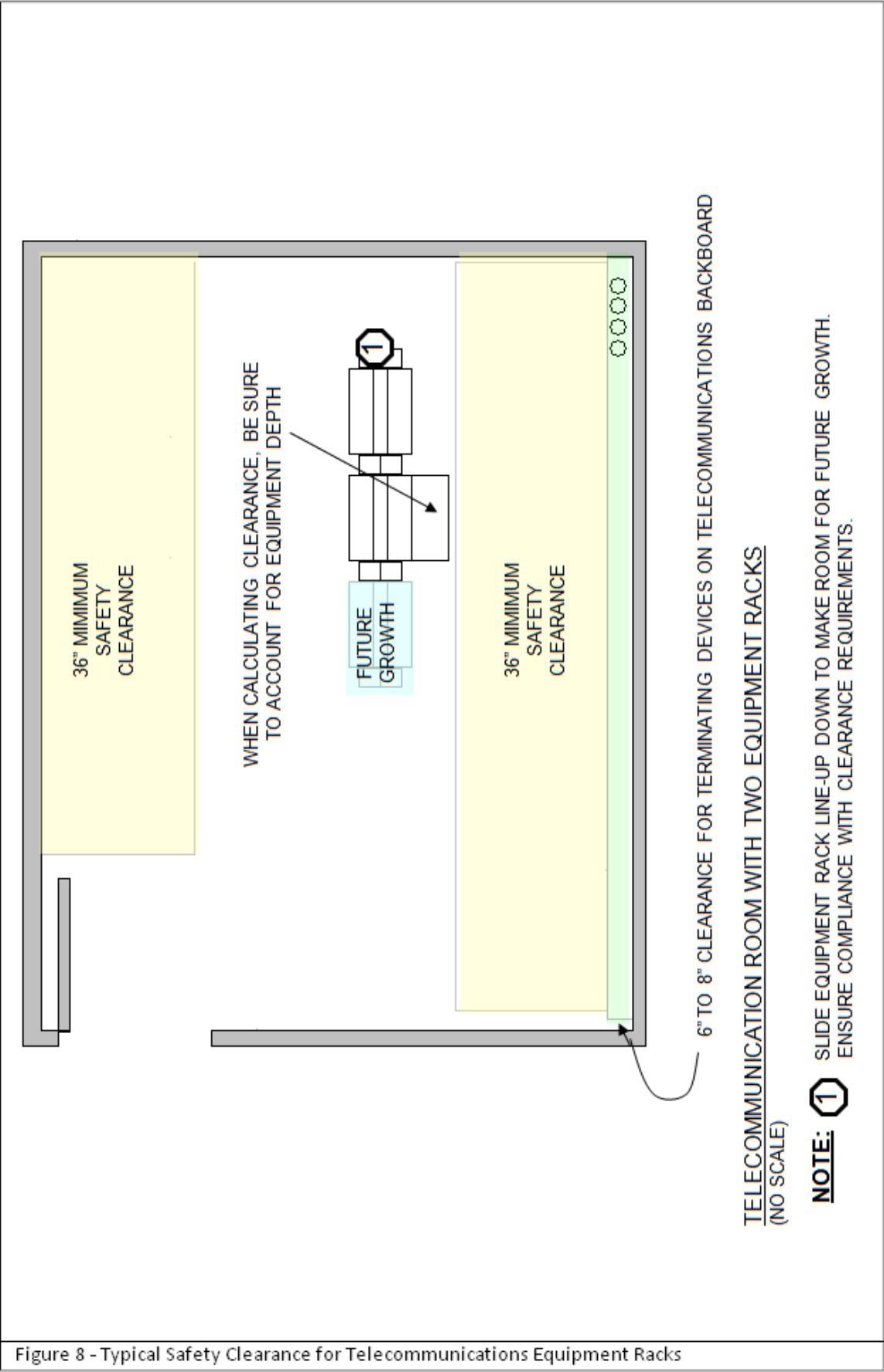


Figure 8 - Typical Safety Clearance for Telecommunications Equipment Racks

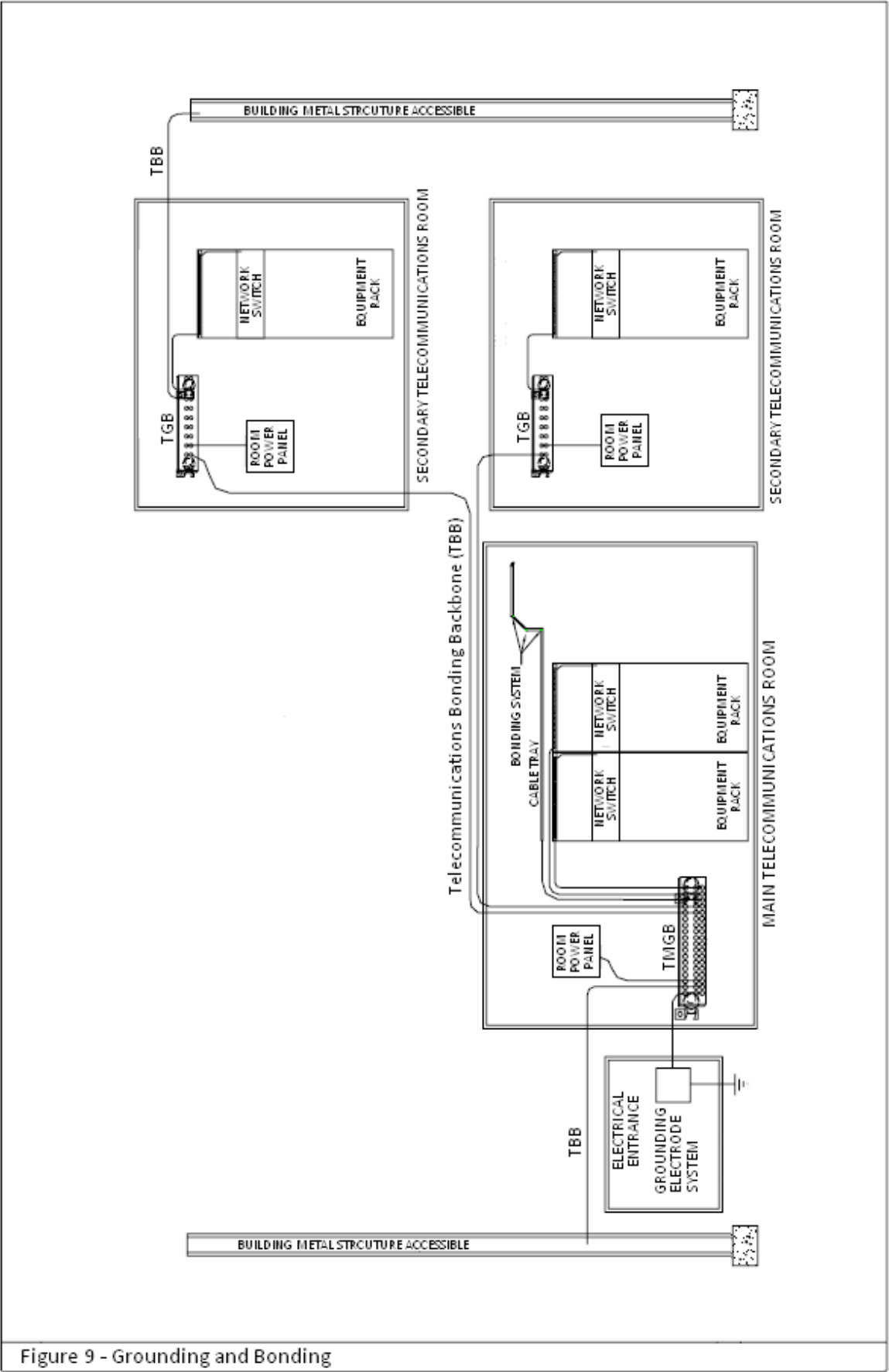


Figure 9 - Grounding and Bonding

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX FF

### Langley Air Force Base Telecommunications OSP Cabling System Standards

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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**Specification  
For  
Outside Plant Telecommunications Cable Installation  
At  
Langley AFB VA**

**Sept 2009**

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## **1.0 DESCRIPTION OF SERVICES**

### **1.1 Provide Outsideplant cabling and infrastructure for all Langley AFB users**

## **2.0. SUPPORTING CONSTRUCTION REQUIREMENTS AND SPECIFICATIONS.**

### **2.1. General Construction Requirements**

2.1.1. The contractor shall remove asphalt, concrete, and other material/debris IAW with applicable Langley AFB Civil Engineer codes. Disposition of any excess dirt will be in compliance with Langley AFB Civil Engineer codes. Any material used for fill (dirt/aggregate, etc.) and compaction of fill will be in compliance with Langley AFB Civil Engineer codes. Contact 1 CS/SCX for applicable codes and instructions regarding this requirement.

2.1.2. Any asphalt, concrete curb or sidewalk replacement will be in compliance with Langley AFB Civil Engineer codes. Contact 1 CS/SCX for applicable codes and instructions regarding this requirement.

2.1.3. Coordinate with 1 CS/SCX to determine if lab testing of removed soil is required.

2.1.4. The contractor will coordinate with Base Civil Engineers (BCE) to determine the best method (trench, bore, etc.) to install buried ducts. Contact 1 CS/SCX for applicable codes and instructions regarding this requirement.

2.1.5. The contractors' bed down area (work storage area) shall be kept clean and orderly and will be free of debris per BCE standards. Contact 1 CS/SCX for applicable codes and instructions regarding this requirement.

2.1.6. The contractor shall restore all work area sites to its original conditions IAW Langley AFB Civil Engineer codes (contact 1 CS/SCX for applicable codes and instructions regarding this requirement). All grass areas where excavation occurs shall be restored to the same or better conditions by using seed or sod and appropriate fill dirt.

2.1.7. The contractor shall coordinate site restoration requirements with 1 CS/SCX and 1 CS/Quality Assurance Evaluator (QAE) **prior** to any site excavations.

### **2.2. General Manhole and Duct Construction Specifications**

2.2.1. Manholes shall have a 10" frame and manhole lid that will not exceed 31¾" (approx.) diameter and will have the word "TELEPHONE" or "COMMUNICATION" on the cover in 2" block letters (See Sketch 2).

2.2.2. The contractor may use either a 3" or 6" riser to obtain the correct grade for the final manhole lid elevation (See Sketch 2).



2.2.3. All manholes and hand holes shall be grounded, bonded and racked IAW with applicable standards identified in Section 6.0 and Sketch 4.

2.2.4. Grade of PVC conduit (Schedule 40, Schedule 80, etc.) to be used for ducts and/or concrete encasement of ducts will be in compliance Langley AFB Civil Engineer codes (See Sketch 6). Contact 1 CS/SCX for applicable codes and instructions regarding this requirement.

2.2.5. 1800 pound mule tape shall be installed in all new ducts.

2.2.6. All manhole seams (i.e. neck of manhole, 2-piece pre-cast manholes, duct holes, etc.) shall be sealed to prevent unnecessary ground water from entering manholes (See Sketch 2).

2.2.7. Manholes shall be placed level and plumb in relationship to the ground elevation and the ceiling shall have a minimum 12-18 inches of ground cover, not including the riser and manhole ring (See Sketch 2).

2.2.8 The inside diameter for all ducts shall be 4" (See Sketch 6).

2.2.9. Conduits shall be buried to allow for a minimum of 42" of select backfill over the top of the proposed duct bank.

2.2.10. Conduits may be installed by open trench method or by directional boring. The government prefers the most cost effective method.

2.2.11. Conduits shall be joined in such a way as to prevent solid matter from entering the joints. Joints shall form a continuous smooth interior surface between joining conduit sections so that cable will not be damaged when pulled past the joint.

2.2.12. Manholes shall include one (1) 12-inch drain opening and one (1) 1-inch ground rod opening in the base, not less than 6 inches or greater than 12 inches from the wall. All manholes shall have cable-pulling irons installed in the floor opposite each duct entry; a 7/8 inch diameter steel bar forming a triangle of 9 inches per side when set. Galvanize to ANSI/ASTM A153 for irregular shaped articles (See Sketch 4 and 5).

2.2.13. Manholes shall include a metal ladder with steps at 16 inches on center and bolted to manhole neck.

2.2.14 Manholes shall include 36in ladder racks with 3in offsets on all walls spaced 18in from walls and 18in between racks

2.2.15 Manholes shall include boding ribbon attached to walls completely around the manhole and attached to the ground rod

2.2.16. Ground rods shall be installed in all new manhole/hand holes; use a 3/4" x 10' copper ground rod. The ground rod shall be sealed to prevent unwanted ground water entrance into the manhole/hand hole. Ground rods shall extend 4" to 6" above the manhole or handhole floor (See Sketch 4).

2.2.17. Asphalt type sealant shall be used to seal all joints in manholes/hand holes.

2.2.18. Spacers shall be used where more than one duct is installed and shall be the standard product of the duct manufacturer for the type and size duct. They shall be located at five-foot intervals, secured to the ducts with #16 gage iron wire (See Sketch 6).

2.2.19. Conduit penetrations into buildings or through above ground foundations, shall be sealed with duct seal or conduit sealer to prevent gas or water entry.

2.2.20. An orange warning tape shall be installed 12" above new ducts. The warning tape shall be of inert plastic film 4 mils thick specifically formulated for prolonged use underground, resistant to alkalis and acids found in soil. It shall have a tensile strength of 30 pounds per 3 inch wide strip. The tape shall bear a continuous printed message repeated every 36 inches. "WARNING COMMUNICATIONS CABLE" or any other suitable warning ribbon approved by 1 CS/QAE.

2.2.21. The contractor shall install suitable duct caps in all new ducts to protect against entrance of dirt and moisture.

2.2.22. Conduits between manholes shall enter and be straight "in-line" so the pattern is identical in each structure (i.e. left top duct in one manhole appears as the right top duct in the other manhole) without any twists along the entire conduit run (See Sketch 7 and 8).

2.2.23. Manhole dimensions, unless otherwise stated in the specification, shall have a minimum width of 6', a minimum length of 10', and a minimum height of 7' (6'W x 10'L x 7'H).

2.2.24. Hand hole dimensions, unless otherwise stated in the specification, shall have a minimum width of 4', a minimum length of 6', and a minimum height of 4' (4'W x 6'L x 4'H).

**Note:** No ducts shall be covered with backfill until 1 CS/QAE performs a sample inspection of the installed duct bank.

**Note:** Exact placement of all manholes shall be determined by 1 CS/QAE and/or 38 EIG/GC based on the contractors recommended solution. Distance between manholes shall not exceed 500' wall-to-wall for this project.

**Note:** Measurements provided in this specification are approximate only. Contractors shall plan accordingly to anticipate possible changes in measurements depending on exact placement of all manholes. The government is not responsible for material shortfalls due to contractors not performing their own detailed survey to include gathering exact measurements prior to ordering conduit, cables, and/or other project related materials.

**Note:** Unless otherwise stated, all 4" PVC or HDPE conduits referenced in this specification shall have an inside diameter measurement of 4 inches.

2.2.25. All ducts shall penetrate manholes perpendicular to the wall surface plane and have bell-ends. The contractor shall use pre-drilled knockouts or use core drill method to establish holes for placement of ducts into all manholes. Chipping or using a jack hammer method to establish holes for conduit placement into the manhole is unacceptable (See Sketch 7 and 8).

2.2.26. When communication ducts cross either power duct or buried power cable, maintain a minimum separation of 3 inches of concrete or 12 inches of well-tamped earth between the two.

2.2.27. Ducts across roads, sidewalks, parking areas, etc. shall be installed a minimum of 42" below grade.

2.2.28. The contractor shall use a 4" to 6" gravel or other aggregate fill to form a base prior to setting manholes/hand holes to minimize manhole or hand hole settlement after installation.

2.2.29. The contractor shall notify 1 CS/SCX or the 1 CS/QAE NLT 10-days prior to inspection of the new manhole and duct system proposed under this SPECIFICATION. No cables shall be installed until all manholes and hand holes have been inspected by 1 CS/QAE.

### **2.3. Manhole and Conduit Installation**

2.3.1 All new outside plant cable installations will be installed in 4" or larger conduit

2.3.2. The contractor shall engineer, furnish, and install all hardware and required EMT conduit once the duct is installed to the building to complete the pathway for cable placement to the Telecommunications Room. 1 CS/QAE and the Contractor shall determine penetration into the facility and location of the terminals as this facility is currently under renovation.

## **3.0. CABLE INSTALLATION.**

**3.1. Cable Requirements.** This project will install all hardware, ladder racking system, backboard, and other support hardware to facilitate the cable installation. The stubbed tails on the MDF connectors shall be installed so the tip cables are feed from the top of the MDF. The tip cables shall be neatly formed on suspended ladder racks and secured IAW applicable Air Force 31W series technical orders.

3.1.1. New MDF connectors shall match the existing connectors.

3.1.2. Form and secure the cable up the backboard to the ladder rack system allowing enough space for the splice while resting on the cable ladder racking system.

3.1.3. For splice closures in the main cable vault, seal the splice using a vault-type re-enterable splice closure with no encapsulant.

3.1.4. All cables larger than 1200-pair shall be 26 American Wire Gauge (AWG). Cables 1200-pair and smaller shall be 24 AWG. All cables shall be pic-filled IAW standards identified in Section 6 of this specification.

### **3.2. Terminal Installation.**

3.2.1 The contractor shall furnish and/or install building entrance terminals (BET) that are Underwriters Laboratory approved for use inside telecommunication rooms and provide the necessary protection IAW applicable commercial and industry standards identified in section of this SPECIFICATION All terminals shall have the three element plug-in gas tube protection

modules that meet the requirements in RUS Bulletin 345-83. The plug-in gas tube protector modules shall be provided to protect against transient over voltages and sneak currents.

3.2.2. The BET shall terminate, protect, and distribute metallic cable pairs to within the facility.

3.2.3. Install R355 Space Saver series Central Office Protector Terminals, stubbed, top fed on the MDF on verticals. The contractor shall install similar terminals to insure the MDF is populated with "like kind" terminals. 1 CS/QAE and the 38th Contractor will determine the proper terminals to be installed.

**Note:** Prior to ordering MDF connectors, the contractor will determine, along with 1 CS QAE, appropriate location for proposed tip splice.

### **3.3. Copper Splice and Closure Specifications**

3.3.1. Only Preformed line products stainless steel re-enterable splice closures specifically designed for underground applications shall be used in this installation. Install following only manufactures directions

3.3.2. The splice closure shall be suitable for pressure encapsulation and shall provide a rigid end plate (plastic or resin laminate) to provide a seal against the cable sheath under pressure for applications at locations where the possibility of immersion exists.

3.3.3. The underground closure shall be sealed, and suitable for enclosing straight, butt, and branch splices in a protective housing. The closure shall be of stainless steel material and shall protect the splice and maintain cable shield electrical continuity in a cable vault, manhole, or hand hole environment.

3.3.4. Filled splice closures shall comply with RUS Bulletin 345-72. The vault closure shall be sealed, non-filled, and suitable for enclosing a straight splice in a closure designed for use in cable vaults.

3.3.5. The closure shall be of a suitable stainless steel or fire retardant material and shall protect the splice and maintain cable shield electrical continuity in a cable vault environment. The number of cable ports in and out of the closure, along with any necessary washers or any plugs for unused ports, shall be suitable for the particular application.

3.3.6. Splices (greater than 100 pair), in which all cables entering the splice is new, will be made with filled 710 modular connectors. Splices 100 pair or less may be made with pic-a-bond connectors. Where pic-a-bond connectors are used, they will be filled. All new splices will utilize the fold-back method.

3.3.7. Splices where existing branch cable is to be transferred in an existing splice (example MH-120) use the type connector (710 modular or pic-a-bond) that is in the splice. That is, do not mix 710 modules and pic-a-bond connectors in the same splice.

3.3.8. Dead complements in cables will not be designated as “DD”, “DP”, “XDD” or any variation thereof. Identify dead complements with the appropriate “A” (or B, etc) count.

3.3.9. Splices will be sealed with appropriately sized stainless steel splice cases.

3.3.10. Buried splice cases will be filled with re-enterable encapsulant,

3.3.11. The contractor shall notify the 1 CS QAE NLT 10-days prior to sealing any splice closures so the government can perform a post inspection of the splices.

3.3.12. All splice closures shall be supported using racking clips, cable racks, and cable hooks.

3.3.13. Splicing connectors, both modular and discrete, shall be IAW RUS Bulletin 345-54.

3.3.14. All unspliced pairs in a splice shall be clear capped using the appropriate splice connector.

### **3.4. Bonding and Grounding.**

3.4.1 In existing manholes, bond the splice case to bonding ribbon, where it exists. The contractor shall furnish and install ground and bonding ribbon in existing manholes and hand holes where none exists.

3.4.2. At proposed buried distribution pedestal locations, install a ¾”x10’ copper clad ground. Ground the cable shield, terminal and pedestal to the ground rod. Use corrosion preventive compound on ground connections.

3.4.3. Ground all new MDF connectors and stub cable shields to the MDF buss bar using the appropriate grounding harness and connectors.

3.4.4. At all BET locations where new cable is installed, ground cable shield to the terminal and ground terminal to the Telecommunications Main Grounding Bus bar (TMGB) or Telecommunications Grounding Bar (TGB). Use #6AWG green insulated wire. Use corrosion preventive compound on ground connections.

3.4.5. Shield bonding connectors, bond bars, braids, ribbons, clamps, etc., shall be used to maintain cable shield continuity at splices and at ground connections. Bonding connectors used shall be IAW RUS Bulletin 345-65. Shields shall be grounded and continuous throughout the cable distribution system as specified by RUS TE&CM 451.2.

3.4.6. Hardware such as corrosion resistant grounding rods, wire, clamps, etc. necessary to properly ground the cable distribution system shall be used. Grounding will have a measured grounding potential value of 10 ohms or less and be IAW MIL-STD-188-124B.

3.4.7. For new manholes install grounding rods at the bottom of the floor inside the manhole near or adjacent to one of the interior corners. The ground rod should extend 6”-8” above the finished floor. Seal the area around the ground rod so no ground water is able to enter the manhole.

3.4.8. Grounds and bonding shall consist of a solid bonding ribbon installed in a closed loop half way between the floor and ceiling of the manholes. Bonding ribbon shall be secured by clamps every 18-24 inches and shall be attached to a ground rod and 6 AWG ground wire.

### **3.5. Cable Tagging & Terminal Stenciling.**

3.5.1. Tags shall be made of plastic corrosion resistive material suitable for submersion under water and stamped with the applicable cable information identified in this SPECIFICATION. Tags will be provided by 1CS/SCOIC. (Note 1cs/Scoic will need two week notice for tag manufacturing)

3.5.2. Tag new cables and re-tag existing cables that is to be re-used. In the cable vault, tag each tip cable. In manholes place a tag on each cable on each side of the splice. In Communication Rooms, tag cable near cable entry point and at the terminal. Tag cables as they pass through a pull box or an LB. Tag cables where they are exposed in basements. Tag to include cable type, cable number, and count.

Example:      P9-24FF  
                 26, 1501-2400+  
                 A, 601-900

3.5.3. Stencil new terminals and re-stencil existing terminals to be retained. Stencil all terminals as determined acceptable by 1CS/QAE. Cable Terminal Covers shall be marked with terminal number, cable number, and terminal count.

Example:      T-945  
                 CA 26  
                 1501-2400

**3.6. Testing.** All test results will be required as applicable to this project. Test results will be required 10 days after completion of all testing. 3 copies will be submitted. One copy will be sent to the identified POC at Langley. 2 copies will be provided to the 38<sup>th</sup> Contracting Office.

3.6.1. Existing Cables. Prior to splicing, test existing pairs to be spliced into the new cable. The contractor's tests shall check for cable faults (grounds, shorts, crosses, opens), splicer's errors (splits, reverses, transpositions), shield continuity and insulation resistance (insulation resistance on existing cables is accomplished on spare pairs only). The contractor shall not be responsible for correcting existing cable faults, splicer's errors, open shield continuity or low insulation resistance; however, the 1 CS QAE must be notified of such conditions immediately upon identification so the government can correct the deficiencies.

3.6.2. New Cables. After splicing and terminating new cable and prior to splicing any new cable into existing cable, the new cable will be tested and documented to be free of cable faults (grounds, shorts, crosses, and opens) and splicer's errors (splits, reverses, and transpositions).

3.6.3. After splicing and terminating new cable and prior to splicing new cable into existing cable, insulation resistance as tested on a minimum of three conductors in each 25 pair group of

the new cable against all other conductors of the cable and the shield, shall be documented to be of a value that is satisfactory for the length and type cable being tested.

3.6.4. After splicing and terminating new cable and prior to splicing new cable into existing cable, test to ensure the cable shield is continuous from the MDF to each distant termination point.

3.6.5. After splicing new cable into existing cable test the cable for end-to-end cable faults (grounds, shorts, crosses, and opens) and splicer's errors (splits, reverses, and transpositions). Any cable faults or splicer's errors not documented on existing cable test shall be cleared by the contractor, if caused by the new cable installation.

3.6.6. Insulation resistance as tested on a minimum of three non-working conductors in each 25 pair group of the cable shall be documented to be of a value that is satisfactory for the length and type cable being tested.

3.6.7. Loop Resistance Tests: After all splicing and terminating is complete, make a D.C. loop resistance measurement on all affected (non working) cable pairs. Measure from all terminals back to the cable origin or central office

3.6.8. Cable Shield Continuity. Test to ensure the cable shield is continuous from the MDF to each distant termination point.

3.6.9. Test results may be recorded on locally developed test sheet.

3.6.10. Where the contractor uses an existing ground point, it shall be tested prior to being connected to the system. Even though the National Electrical Code calls for a resistance to ground not to exceed 25 ohms, Military Handbook 419A, paragraph 2.2.2.2 states that 25 ohms is not low enough. In order to protect personnel and equipment, MIL-HDBK 419A recommends a design goal of 10 ohms for communications systems where practical. If the ground point proves unsuitable, the contractor shall notify the 1 CS QAE in writing of the defective ground. The tests to be performed on the grounds shall measure the ground potential (ability to dissipate voltage through the ground point to the earth).

## **4.0. FIBER OPTIC (FO) CABLE INSTALL**

### **4.1. Manhole Duct Support**

4.1.1. The government mandates the use of 3 cell Maxcell cloth, collapsible, mesh type inner duct to be used during this installation. If needed, the 1 CS/QAE shall assist the contractor in identifying sources where this specific type of inner duct may be acquired.

4.1.2. All inner ducts shall be secured in manholes and hand holes. The inner duct needs to be secured to prevent the inner duct from creeping back into the 4" ducts during cable placement.

4.1.3. All FO cables shall be racked IAW applicable standards identified in this specification.

## **4.2. FO Cable Placement**

4.2.1 All FO cables will be installed as homeruns to the nearest ITN designated by 1CS/SCXP. No splices will be present for any new fiber optic installs.

4.2.1.1 The contractor shall provide for a 50 ft maintenance loop of FO cables in manholes IAW applicable standards identified in Section 6 of this specification.

## **4.3. Fiber Splicing and Splice Closures**

4.3.1 Splices will only be present if exception is approved by 1CS/SCXP. All FO cables will be homeruns to nearest ITN.

4.3.2. All splice closures shall meet the same specifications identified in Section 3 of this specification as relative to fiber optic cable splices in manhole applications.

4.3.3. All cables shall be spliced by fusion method and sealed in an air tight closure with encapsulation.

## **4.4. Fiber Terminations**

4.4.1. All terminations shall be the “ST” type Hot Melt connectors.

## **4.5. FO Cable Tagging & Terminal Stenciling.**

4.5.1. The contractor shall tag FO cables the same as for copper cables identified in Section 3 of this specification. See the example below for manholes:

Example:      72L8.3F  
                 FO 1025/945, 1-24

4.5.2. The contractor shall stencil the FODP for each facility the same as for copper terminals identified in Section 3 of this specification. See the example below for building applications:

Example:      FO 1025/945, 1-24

## **4.6 Testing FO Cables**

4.6.1. The contractor shall test all FO cables using Power meter and light source for the following as a minimum:

- a. End-to-End to obtain distance
- b. Power loss measurements (dB loss as compared to distance)



**Note:** 1 CS/QAE shall determine preferred method of testing IAW applicable standards for Langley AFB.

4.6.2. The contractor shall provide documentation reflecting all measurements and test results the same as identified in Section 3 of this specification.

## **5.0. Drawings.**

5.1.1 The contractor shall provide all drawings in either AutoCAD or Microstation formatted drawings to 1CS/SCXP. The contractor shall contact 1CS/SCXP for information regarding software requirements to accomplish all CSIR updates identified in this SPECIFICATION.

## **6.0. APPLICABLE DOCUMENTS, INSTALLATION STANDARDS, SITE DRAWINGS.**

6.1.1 The Contractor shall comply with all federal laws, codes, regulations, and statutes applicable to performance of this contract, including but not limited to those specified in the tables below. The following tables provide locations where some documents may be obtained. It is the Contractor's responsibility to obtain and adhere to all applicable federal standards. The Government will identify and provide the location to the contractor to obtain equipment-unique technical documentation to support Government Furnished Property (GFP).

6.1.2. The federal, state, commercial, and military standards listed below were used to develop and engineer this proposed installation. The contractor shall have a working knowledge and apply these standards to complete the tasks identified in this specification. All standards that are applicable to this installation will be used by government representatives for final acceptance of this project.

### **6.2. Federal.**

<b>NUMBER</b>	<b>TITLE</b>	<b>WEBSITE OR LOCATION</b>
OSHA	Occupational Safety and Health Administration (OSHA)	<a href="http://www.osha.gov">http://www.osha.gov</a>
EPA	Environmental Protection Agency (EPA)	<a href="http://www.epa.gov/">http://www.epa.gov/</a>
EPA	EPA Rules, Regulations, and Legislation	<a href="http://www.epa.gov/epahome/rules.html">http://www.epa.gov/epahome/rules.html</a>
FAA	Federal Aviation Authority (FAA)	<a href="http://www.faa.gov">http://www.faa.gov</a>
FAA	FAA Regulation and Certification	<a href="http://www.faa.gov/avr/index.cfm">http://www.faa.gov/avr/index.cfm</a>
RUS	Rural Utility Services (RUS)	<a href="http://www.usda.gov/rus/telecom/">http://www.usda.gov/rus/telecom/</a>
RUS Bulletin 1753F-150	RUS Form 515a - Specifications and Drawings for Construction of Direct Buried Plant	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>

RUS Bulletin 1753F-151	RUS Form 515b - Specifications and Drawings for Construction of Underground Plant	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1753F-153	RUS Form 515d - Specification and Drawings for Service Installation at Customer Access Locations	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1753F-401	Standards for Splicing Copper and Fiber Optic Cable PC-2)	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1753F-302	Specifications for Outside Plant Housings and Serving Area Interface System (PE-91)	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Regulation 1755.900	Specification for Filled Fiber Optic Cables	<a href="http://www.usda.gov/rus/telecom/publications/publications.htm">http://www.usda.gov/rus/telecom/publications/publications.htm</a>
RUS Bulletin 345-29	Self Supporting Cable (PE-38)	USDA/RUS/PDRA, Attn: Adam Miller, 1400 Independence Ave., Room 4028-S, Washington DC 20256
RUS Bulletin 345-65	Shield Bonding Connectors (PE-33)	USDA/RUS/PDRA, Attn: Adam Miller, 1400 Independence Ave., Room 4028-S, Washington DC 20256
RUS Bulletin 1753F-205	Specification for Filled Telephone Cable (PE-39)	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1753F-801	Service Installations at Customer Access Locations (PC-5A)	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 345-54	REA Specification for Telephone Cable Splicing Connectors (PE-52)	USDA/RUS/PDRA, Attn: Adam Miller, 1400 Independence Ave., Room 4028-S, Washington DC 20256
RUS Bulletin 345-72	Specifications for Filled Splice Closures, PE-74	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 345-83	Specification for Gas Tube Surge Arresters, PE-80	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1753F-207	Specifications for Terminating Cables (PE-87)	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1753F-208	Specifications for Filled Telephone Cables with Expanded Insulation (PE-89)	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1753F-601	Specifications for Filled Fiber Optic Cables (PE-90)	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1751F-640	Design of Buried Plant, Physical Considerations	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1751F-641	Construction of Buried Plant	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1751F-642	Construction Route Planning Of Buried Plant	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1751F-643	Underground Plant Design	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>

RUS Bulletin 1751F-644	Underground Plant Construction	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1751F-805	Electrical Protection at Subscriber Stations	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS Bulletin 1751F-815	Electrical Protection of Outside Plant	<a href="http://www.usda.gov/rus/telecom/publications/bulletins.htm">http://www.usda.gov/rus/telecom/publications/bulletins.htm</a>
RUS TE&CM, Section 825	Situations Requiring Special Protection	USDA/RUS/PDRA, Attn: Adam Miller, 1400 Independence Ave., Room 4028-S, Washington DC 20256
DODD 5220.22	DOD Industrial Security Program Directive	<a href="http://www.dtic.mil/whs/directives/corres/html/522022.htm">http://www.dtic.mil/whs/directives/corres/html/522022.htm</a>
DoD JTA ver. 4	Department of Defense Joint Technical Architecture	<a href="http://www-jta.itsi.disa.mil/jta/JTA40_071702.pdf">http://www-jta.itsi.disa.mil/jta/JTA40_071702.pdf</a>
AFI 33-133	Joint Technical Architecture – Air Force	<a href="http://www.e-publishing.af.mil/pubfiles/af/33/afi33-133/afi33-133.pdf">http://www.e-publishing.af.mil/pubfiles/af/33/afi33-133/afi33-133.pdf</a>
FAA Handbook OA P 8200.1	United States Standard Flight Inspection Manual	<a href="http://avnwww.jccbi.gov/icas/PDF/82001a.pdf">http://avnwww.jccbi.gov/icas/PDF/82001a.pdf</a>
ETL 02-12	Engineering Technical Letter Communications and Information System Criteria for Air Force Facilities	<a href="http://www.afcesa.af.mil/Publications/ETLs/ETL 02-12.pdf">http://www.afcesa.af.mil/Publications/ETLs/ETL 02-12.pdf</a>

### 6.3. Air Force Standard Installation Practices Technical Orders.

NUMBER	TITLE
31-10-2	Fanning and Forming Conductors for Ground C-E Equipment
31-10-6	Cable Racks, Troughs and Their Supports
31-10-7	Terminating and soldering Electrical Connections
31-10-9	Marking Site Layouts
31-10-10	Anchoring Devices for Ground C-E Equipment
31-10-11	Cross-connections and Strapping of Fixed Ground C-E Components
31-10-12	Metal Ducts and Conduits
31-10-13	Cabling for Fixed Ground C-E Equipment
31-10-24	Grounding, Bonding, and Shielding
31-10-27	Equipment Designations
31-1-141	Basic Electronics Technology
31R-10-5	Antenna Systems Maintenance, Repair, and Testing
31S9-2GSS42-1	Exterior Intrusion Detection System (EIDS)
31-10-34	Standard Installation Practices – Fiber Optic Communication Cables And Connectors
31W3-10-12	AF Communication Command (E-1 Standard) -- Standard Installation Practices -- Outside Plant Cable Placement
31W3-10-13	AF Communications Service (Engineering- Installation Standard) -- Standard Installation Practices -- Outside Plant Cable Splicing
31W3-10-15	Air Force Communications Command (E-I Standard) - Outside Plant Cable Testing

31W3-10-22	Telecommunications Engineering, Outside Plant Telephone
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(Copies of the above documents may be obtained from SM-ALC/MMEDTD, McClellan AFB, CA 95652 - 5609.)

#### 6.4. Military Standards.

NUMBER	TITLE
MIL-HDBK-419A	Grounding Bonding and Shielding for Electronic Equipment and Facilities
MIL-STD-188-124B	Grounding Bonding and Shielding
MIL-HDBK-1857	Grounding, Bonding and Shielding Design Practices
MIL-HDBK-454A	General Guidelines for Electronics Equipment

(Copies of the above documents may be obtained from the Naval Publications and Forms Center (NPFC 105), 5801 Tabor Ave, Philadelphia PA 19120.)

**6.5. State, Local, and Site-specific Regulations. The Contractor shall comply with all applicable state, local, and site-specific codes, regulations, and statutes related to the specific task order.**

**6.6. Commercial Standards and Manuals. The Contractor shall comply with the following commercial standards where applicable. Other commercial standards may apply to individual projects and will be stated in individual task orders. It is the Contractor's responsibility to identify and obtain applicable standards.**

NUMBER	TITLE	WEBSITE OR LOCATION
Building Industry Consulting Service International (BICSI)	Building Industry Consulting Service International, Inc (BICSI)	<a href="http://www.bicsi.org/">http://www.bicsi.org/</a>
NFPA 70	National Fire Protection Association (NFPA)	<a href="http://www.nfpa.org/">http://www.nfpa.org/</a>
ANSI	American National Standards Institute (ANSI) and Internet Standards Resources	<a href="http://www.ansi.org/">http://www.ansi.org/</a>
EIA/TIA	Engineering: EIA/TIA Standards See Commodity Specific Appendices and Individual Task Orders	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-526-7	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>

TIA/EIA-526-14	Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant – OFSTP-14	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-568-B.1	Commercial Building Telecommunications Cabling Standard Part 1: General Requirements	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-568-B.2	Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-568-B.3	Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components Standard	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-569	Commercial Building Standards for Telecommunications Pathways and Spaces	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-570	Residential Telecommunications Cabling Standard	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-598	Optical Fiber Cable Color Coding	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-607	Commercial Building Grounding and Bonding Requirements for Telecommunications	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
TIA/EIA-758	Customer-Owned Outside Plant Telecommunications Cabling Standard	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
EIA-310	Racks, Panels and Associated Equipment	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
EIA SP-2840-A	Commercial Building Telecommunications Cabling Standard	<a href="http://www.eia.org/">http://www.eia.org/</a> <a href="http://www.tiaonline.org/">http://www.tiaonline.org/</a>
ICEA S-80-576	Telecommunications Wire and Cable for Wiring of Premises	Insulated Cable Engineer Association, Inc., P.O. Box P, South Yarmouth MA 02664; Telephone (508) 394-4424
GR-409	Generic Requirements for Premises Fiber Optic Cable	<a href="http://telecom-info.telcordia.com/site-cgi/ido/index.html">http://telecom-info.telcordia.com/site-cgi/ido/index.html</a>
GR-20	Generic Requirements for Optical Fiber and Optical Fiber Cable	<a href="http://telecom-info.telcordia.com/site-cgi/ido/index.html">http://telecom-info.telcordia.com/site-cgi/ido/index.html</a>
NEMA TC 2	Electrical Polyvinyl Chloride (PVC) Tubing and Conduit	<a href="http://www.nema.org/index_nema.cfm/1260/">http://www.nema.org/index_nema.cfm/1260/</a>

NEMA TC 6&8	PVC Plastic Utilities Duct for Underground Installations	<a href="http://www.nema.org/index_nema.cfm/1260/">http://www.nema.org/index_nema.cfm/1260/</a>
NEMA TC 9	Fittings for PVC Plastic Utilities Duct for Underground Installation	<a href="http://www.nema.org/index_nema.cfm/1260/">http://www.nema.org/index_nema.cfm/1260/</a>

#### 6.7. Specification Drawings:

Sketch 1, Manhole/Duct Installation Specifications  
 Sketch 2, Manhole and Ring Specifications  
 Sketch 3, Manhole Racking and Bonding Specifications  
 Sketch 4, Manhole Racking and Bonding Specifications  
 Sketch 5, Duct/Trench Configuration  
 Sketch 6, Duct/Trench Configuration  
 Sketch 7, Duct/Trench Configuration  
 Sketch 8, Manhole Duct/Cable Assignment

#### 7.0. CONTRACTOR PERSONNEL.

**7.1.1. Program Manager.** The contractor shall provide a Program Manager (PM) and alternate(s) responsible for contract performance and continuity.

**7.1.2.** The contractor shall identify the Program Manager or alternate's range of authority to act for the contractor relating to daily contract operation.

**7.1.3.** The Contractor shall designate the Contractor's on-site team leader and alternate(s) as the Site POC for individual projects in their Site Visit Request Letter.

**7.1.4.** The Site POC or alternate(s) shall be on site during duty hours until project completion. The Site POC shall be the interface for all work site communications with the government, including quality, safety, and discrepancy matters. The Site POC shall provide 1 CS/SCX and 1 CS/QAE with their contact information (i.e. phone number, e-mail, etc.).

**7.1.5.** The Contractor Program Manager shall provide the following while performing any tasks associated with this SPECIFICATION to the Base Communication Officer's designee, 1 CS/SCX Plans and Programs Office:

7.1.5.1. Weekly project status report to 1 CS/SCX.

7.1.5.2. A project timeline that illustrates critical milestones and/or other significant points of interest (i.e. road closures, facility access, etc.).

7.1.5.4. Changes in schedule or delays that will cause a change in the project timeline.

7.1.5.5. Submit all work order clearance requests (digging permits) to 1 CS/SCX NLT 2 weeks in advance of schedule excavations.

**7.1.6. The Program Manager, Site POC, and respective alternate(s) shall be able to read, write, speak, and understand English. The Site Visit Request Letter shall be submitted to the 1st Communications Squadron's Plans and Programs Flight not later than two weeks prior to base visit or as negotiated on individual task orders. The Visit Request Letter shall be IAW AFFARS 5352.242-9000.**

7.1.7. The Contractor shall contact 1 CS/SCX 10-days in advance to obtain electronic copies of the CSIRS. 1 CS/SCX shall provide two (2) copies of the base CSIRS in electronic format.

## **8.0. GEOSPATIAL INFORMATION**

8.1.1 Format (see Attachment 1). The contractor shall provide geospatial information identified in attachment 1 of the specification.

8.1.2. Data Delivery. The contractor shall provide the geospatial information in electronic format to each of the following:

1 CS/SCX,  
175 Sweeney Blvd.  
Langley AFB, Va. 23665

38 EIG/GCA, Attn: Langley AFB STEM-B  
4064 Hilltop Rd.  
Tinker AFB, OK 73145



## ATTACHMENT 1 GEOSPATIAL INFORMATION

### 1.0 General Global Positioning System Service Requirements

1.1. The Contractor shall use GPS equipment supplemented with land surveying equipment (*Specify any additional equipment known to be needed, for example, and electronic underground cable locating equipment will be needed to locate direct buried cable*), necessary to collect required Communication Feature Location Data (CFLD) following the “Geospatial Positioning Accuracy Standards, Part 4: Architecture, Engineering, Construction, and Facilities Management,” (FGDC)-STD-007.4-2002 published by the Federal Geographic Data Committee. This standards document can be found at

<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part4/FGDC-endorsed-standard>. Coordinates of communication features shall be located to within (*Specify how accurately the feature must be located, for example, one meter (Suggestion: Check with the local Base Civil Engineer or local Geo Integration Office for their accuracy standard. Within one meter meets the GeoBase accuracy standard.)*) spatial accuracy in the horizontal plane at the 95% confidence level. The methodology used for testing and reporting accuracy shall be in accordance with the Geospatial Positioning Accuracy Standards, Part 3: “National Standard for Spatial Data Accuracy”, (FGDC)-STD-007.4-2002) This standards document can be found at:  
<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3>

1.2. Geospatial data shall overlay on the installation’s most current orthorectified imagery provided by (*Specify the organization who will supply the imagery files, for example, 1CES/CEG Langley AFB, Virginia*). The collected data will incorporate the coordinate and projection system of the imagery, (*Specify the coordinate and projection systems, for example, NAD 83 Virginia State Plane South, FIPS 4502*).

#### 1.3. Required Attribute Data and Metadata for CFLD Population

1.3.1. The contractor shall use GPS to determine horizontal position of communication features and shall record all required CFLD using the attribute, and domain table formats and values given in Appendix A.

1.3.2. Entity naming convention, attribute fields, and domain values used for data entry in Appendix A are derived from the 38th EIG Communications Mission Data Set Schema.

1.3.3. The contractor shall complete all metadata elements marked mandatory and mandatory-if-applicable as defined by the *FGDC Content Standards for Digital Geospatial Metadata* for each set of CFLD collected. This standards document can be found at: [http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/base-metadata/v2\\_0698.pdf](http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/base-metadata/v2_0698.pdf)

1.3.4. Metadata must include an NSSDA accuracy statement at the 95% confidence level. “Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data



Accuracy,” published by the Federal Geographic Data Committee (FGDC), dated July 1998. This standards documentation can be found at:

<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3>

1.4. Quality Control: The contractor shall utilize a topology build and clean routine and assure the CFLD has the following:

- No erroneous overshoots, undershoots, dangles or intersections in the line work. Features shall be snapped where applicable, for example, Comm\_Dbsplice snapped to Comm\_Path\_Segment.
- Lines should all be continuous. Pseudo-nodes should only exist where the attributes of a line change.
- No sliver polygons.
- All polygons completely close and have a single unique centroid.
- Digital representation of the common boundaries for all graphic features must be coincident, regardless of feature layer.

1.5. Spatial coordinates for the location of manholes and cable vaults shall be recorded for the center of the manhole lid. Spatial coordinates for the location of handholes, pedestals, and buried splices shall be recorded for the top center of the feature. Spatial coordinate data for the location of cable installation pathways shall be recorded at a minimum every 50 feet and each offset, turn, or bend in a cable installation pathway must also be recorded so that the coordinates for any point along the turn pathway will fall within the allowable accuracy.

1.6. The Contractor shall be responsible for providing all required GPS, land surveying equipment, data loggers and other equipment including computer software, hardware, and any other tools, labor, and materials necessary to provide the CFLD electronically on CD-ROM storage media.

## 2.0 Requirements for CFLD Deliverables

2.1. The CFLD attribute and location information shall be stored and submitted in an Environmental Systems Research Institute (ESRI) Shape File format. The shape files must be compatible with the current software used by the (*Specify the primary organization that will utilize the data for example: 1CES/CEG Langley AFB, Virginia*). Its format shall be within a folder named the same as the prefix of the shape file. For Example, if the shape file is named "points\_lafb\_28.shp" the folder would be named "points\_lafb\_28". The folder shall contain all the files that make up the general shape file, i.e., ".shp", ".shx", ".dbf", etc. along with the specified metadata file. The shape files shall have a spatial reference (.prj) file included that specifies the parameters of the coordinate system.

2.2. Metadata be formatted and stored as an XML document that is compatible with the submitted shape files and software of the organization specified in Paragraph 2.1.1. Calculation worksheets showing compliance with NSSDA accuracy statement at the 95% confidence level shall be submitted as an excel (.xls) file.

2.3. The contractor shall provide a quality control (QC) report that must state whether all inconsistencies in the data generated were corrected by utilizing the topology build and clean routine, or it must detail the remaining errors by case.

**3.0. Submittal of Deliverables.** CFLD shape files, metadata XML files, quality control report and worksheets validating the NSSDA accuracy statement shall be submitted on CD-ROM storage media to ( *Specify the local Contracting Office or other organization and Point of Contact that is going to receive the deliverables, for example, 1 CS/SCX, Attn: Mr. John Doe, Langley AFB, VA* ).

*(Resources:)*

*Positional Accuracy Handbook: Using the National Standard for Spatial Data Accuracy to measure and report geographic data quality.* Copies of the Positional Accuracy Handbook can be downloaded at <http://www.lmic.state.mn.us/resource.html?Id=1852>

*An Image Map of the Content Standard for Digital Geospatial Metadata*  
Version 2 - 1998 (FGDC-STD-001 June 1998) published by U.S. Geologic Survey, Biological Resources Copies can be downloaded at <http://biology.usgs.gov/fgdc.metadata/version2/>

*Content Standard for Digital Geospatial Metadata Workbook (For use with FGDC-STD-001-1998) Version 2.0* Federal Geographic Data Committee May 1, 2000 can be downloaded at <http://www.fgdc.gov/metadata/geospatial-metadata-standards>

**TABLE A**  
**Entities, Attributes, and Domain Values for Recording Required**  
**Communication Feature Location Data**

**(BASIC COMM PATH TEMPLATE)**

**A.1 Feature Attributes for Comm-Path Entities**

**A.1.1 Coestpbx (Pullbox)**

**Definition**

An enclosed structure that aids in pulling cable. No splices are allowed in a pullbox.

**Geometry type**

Point

**Attributes**

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
FEAT_DESC	Feature Description Text	A description of the feature.	Char(60)	Required	SDS	
DISPOSTN_D	Disposition Code	The status of the subject item (e.g., permanent, temporary, proposed, abandoned, etc.), from lists or entered from field inspections.	Char(16)	Required	SDS	D_DPOBJ
NAME	Identifier Name	The standard identifier name (i.e. PB-3001A)	VARCHAR2(20)	Required		
MAPSRC_D	Map Source Discriminator	DISCRIMINATOR - Used to indicate the source of data for the spatial position of this graphic. This is used for planning, and digging permits.	Char(16)	Required (Set default value to GPS_FLDLOC)	IUO	D_DATSRC
MAPACU	Spatial Accuracy in Meters	Describes the spatial accuracy of mapsrc_d. in meters, +/- of where the feature may actually be. For example, if you are using GPS and its only accurate to 1 meter, put a 1 in this field.	Real	Required	IUO	

**A.1.2 Coestmhl (Manhole)****Definition**

An enclosed structure (manhole, or handhole). A butterfly layout is used that shows the floor and walls flattened out so that duct openings can be drawn on the walls. This must be represented as one polygon (one row in the table). The point is used to show the center of the manhole/handhole cover.

**Geometry type**

Site (Point)

**Child features/tables**

Cohstcpn (Comm Path Node)

**Attributes**

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
MHL_TYPE_D	Type Code	The type of manhole.	Char(16)	Required for new installation or repair	SDS	D_MHTYP
MH_MAT_D	Material Code	The material composition of the manhole.	Char(16)	Required for new installation or repair	SDS	D_COSTRM
DRAIN_TY_D	Drain Type Code	An indication of the method of removing stormwater from the manhole.	Char(16)	Required for new installation or repair	SDS	D_TYDRN
FC_TYP_D	Frame and Cover Type Code	The type of manhole frame/cover.	Char(16)	Required for new installation or repair	SDS	D_COVTYP
FUNCTION_D	Function Code	The function of the manhole.	Char(16)	Required for new installation or repair	SDS	D_MHFUN
SPL_RCK_D	Splicing Racks Code	Are there splicing racks in the manhole (Y/N).	Char(16)	Required for new installation or repair	SDS	D_BOOLEAN
NARRATIVE	Descriptive Text	A description or other unique information concerning the subject item, unlimited length (SDSFIE export limited to first 240 characters).	Memo	Optional	SDS	
DISPOSTN_D	Disposition Code	The status of the subject item (e.g., permanent, temporary, proposed, abandoned, etc.), from lists or entered from field inspections.	Char(16)	Required	SDS	D_DPOBJ
DATE_INST	The date the riser was installed. Format for date is YYYYMMDD	Date (and Time if available) installed.	Integer(1)	Required for new installation or repair	SDS	

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
	(i.e., September 15, 1994 = 19940915).					
NAME	Identifier Name	The standard identifier name (i.e. MH-19).	Char(20)	Required	SDS	
DIAMETER	Diameter	Diameter.	Real	Required for new installation or repair	SDS	
DEPTH	Depth	Depth of horizontal cross-section.	Real	Required for new installation or repair	SDS	
WIDTH	Width	Width of horizontal cross section.	Real	Required for new installation or repair	SDS	
HEIGHT	Height	Height.	Real	Required for new installation or repair	SDS	
SIZE_U_D	Size Unit Measure Code	Size (Diameter, Depth, Width, Height) Unit of Measure.	Char(16)	Required for new installation or repair	SDS	
MAPSRC_D	Map Source Discriminator	DISCRIMINATOR - Used to indicate the source of data for the spatial position of this graphic. This is used for planning, and digging permits.	Char(16)	Required (Set default value to GPS_FLDLOC)	IUO	D_DATSRC
MAPACU	Spatial Accuracy in Meters	Describes the spatial accuracy of mapsrc_d. in meters, +/- of where the feature may actually be. For example, if you are using GPS and its only accurate to 1 meter, put a 1 in this field.	Real	Required	IUO	

**A.1.3 Coestvlt (Vault)****Definition**

An enclosed structure in a facility used for cable entrance.

**Geometry type**

Site (Point)

**Child features/tables**

Cohstcpn (Comm Path Node)

**Attributes**

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
DISPOSTN_D	Disposition Code	The status of the subject item (e.g., permanent, temporary, proposed, abandoned, etc.), from lists or entered from field inspections.	Char(16)	Required	SDS	D_DPOBJ
NARRATIVE	Descriptive Text	A description or other unique information concerning the subject item, unlimited length (SDSFIE export limited to first 240 characters).	Memo	Optional	SDS	
VLT_MAT_D	Vault Material Code	Discriminator References d_pipmat table, Used to describe the material composition of the vault.	Char(16)	Required for new installation or repair	SDS	D_COSTRM
DATE_INST	Date Installed	Date (and Time if available) installed.	Integer(1)	Required for new installation or repair	SDS	
NAME	Identifier Name	The standard identifier name (i.e. MH-19).	Char(20)	Required	SDS	
DIAMETER	Diameter	Diameter.	Real	Required for new installation or repair	SDS	
DEPTH	Depth	Depth of horizontal cross-section.	Real	Required for new installation or repair	SDS	
WIDTH	Width	Width of horizontal cross section.	Real	Required for new installation or repair	SDS	
HEIGHT	Height	Height.	Real	Required for new installation or repair	SDS	

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
SIZE_U_D	Size Unit Measure Code	Size (Diameter, Depth, Width, Height) Unit of Measure.	Char(16)	Required for new installation or repair	SDS	D_UOMDIS (UOM - Distance)
MAPSRC_D	Map Source Discriminator	DISCRIMINATOR - Used to indicate the source of data for the spatial position of this graphic. This is used for planning, and digging permits.	Char(16)	Required (Set default value to GPS_FLDLOC)	IUO	D_DATSRC
MAPACU	Spatial Accuracy in Meters	Describes the spatial accuracy of mapsrc_d. in meters, +/- of where the feature may actually be. For example, if you are using GPS and its only accurate to 1 meter, put a 1 in this field.	Real	Required	IUO	

## A.1.4 Coestped (Pedestal)

**Definition**

An above-ground enclosed structure that provides access to buried plant and a place to house splices, terminals, etc.

**Geometry type**

Site (Point)

**Child features/tables**

Cohstcpn (Comm Path Node)

**Attributes**

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
TYPE_D	Type Code	The type of pedestal.	Char(16)	Required	SDS	D_COPEd
TERMINAL_D	Terminal Existence Code	A Boolean indicating the presence of a terminal (Y/N).	Char(16)	Required for new installation or repair	SDS	D_BOOLEAN
BONDED_D	Bonded Code	A Boolean indicating the presence of a bonded terminal (Y/N).	Char(16)	Required for new installation or repair	SDS	D_BOOLEAN
NARRATIVE	Descriptive Text	A description or other unique information concerning the subject item, unlimited length (SDSFIE export limited to first 240 characters).	Memo	Optional	SDS	
DISPOSTN_D	Disposition Code	The status of the subject item (e.g., permanent, temporary, proposed,	Char(16)	Required	SDS	D_DPOBJ

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
		abandoned, etc.), from lists or entered from field inspections.				
DATE_INST	Date Installed	Date (and Time if available) installed.	Integer(1)	Required for new installation or repair	SDS	
NAME	Identifier Name	The standard identifier name (i.e. PED-19).	Char(20)	Required	SDS	
DIAMETER	Diameter	Diameter.	Real	Required for new installation or repair	SDS	
DEPTH	Depth	Depth of horizontal cross-section.	Real	Required for new installation or repair	SDS	
WIDTH	Width	Width of horizontal cross section.	Real	Required for new installation or repair	SDS	
HEIGHT	Height	Height.	Real	Required for new installation or repair	SDS	
SIZE_U_D	Size Unit Measure Code	Size (Diameter, Depth, Width, Height) Unit of Measure.	Char(16)	Required for new installation or repair	SDS)	D_UOMDIS (UOM - Distance)X
COSTRM_D	Material Code	The material composition of the pedestal.	Char(16)	Required for new installation or repair	SDS	COSTRM_D
MAPSRC_D	Map Source Discriminator	DISCRIMINATOR - Used to indicate the source of data for the spatial position of this graphic. This is used for planning, and digging permits.	Char(16)	Required (Set default value to GPS_FLDLOC)	IUO	D_DATSRC
MAPACU	Spatial Accuracy in Meters	Describes the spatial accuracy of mapsrc_d. in meters, +/- of where the feature may actually be. For example, if you are using GPS and its only accurate to 1 meter, put a 1 in this field.	Real	Required	IUO	



**A.1.5 Coestdbs (Dbsplice)****Definition.**

An enclosed structure that represents a splice case (aerial or buried).

**Geometry type**

Site (Point)

**Child features/tables**

Cohstcpn (Comm Path Node)

**Attributes**

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
CAS_MAT_D	Case Material Code	Used to describe the material composition of the splice case.	Char(16)	Required for new installation or repair	SDS	D_SPCMAT
CAS_TYP_D	Case Type Code	Used to describe the type of splice case.	Char(16)	Required for new installation or repair	SDS	D_SPCCAS
REMARKS	Descriptive Text	A description or other unique information concerning the subject item, unlimited length (SDSFIE export limited to first 240 characters).	Memo	Optional	SDS	
DATE_INST	The date the riser was installed. Format for date is YYYYMMDD (i.e., September 15, 1994 = 19940915).	Date (and Time if available) installed.	Integer(1)	Required for new installation or repair	SDS	
DISPOSTN_D	Disposition Code	The status of the subject item (e.g., permanent, temporary, proposed, abandoned, etc.), from lists or entered from field inspections.	Char(16)	Required for new installation or repair	SDS	D_DPOBJ
MAPSRC_D	Map Source Discriminator	DISCRIMINATOR - Used to indicate the source of data for the spatial position of this graphic. This is used for planning, and digging permits.	Char(16)	Required (Set default value to GPS_FLDLOC)	IUO	D_DATSRC
MAPACU	Spatial Accuracy in Meters	Describes the spatial accuracy of mapsrc_d. in meters, +/- of where the	Real	Required	IUO	

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
		feature may actually be. For example, if you are using GPS and its only accurate to 1 meter, put a 1 in this field.				

### A.1.6 Cohstpth (Comm Path Segment)

#### Definition

Link that represents an enclosure path of comm. items outside of a building, manhole, pedestal, or other enclosed structure. For ductbanks, using a parent-child hierarchy, comm-path segment can represent the virtual path, ductbank, duct, and innerducts. For ducts, using a parent-child hierarchy, comm-path segment can represent the virtual path, duct, and innerducts. For direct-buried cables at road-crossings, using a parent-child hierarchy, comm-path segment can represent the virtual path, road-crossing duct, and direct-buried cables. It can also represent the path of aerial cable, cable-bridges, and cable-troughs.

#### Geometry type

Polyline

#### Parent features/tables

Cohstdda (Duct), Cohstcpn (Comm Path Node)

#### Attributes

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
PATH_TYP_D	Comm-Path Type Code	A discriminator field that describes what type of thing this segment is representing.	Char(16)	Required	SDS	D_COPTHT
DEEP_ELV	Minimum Depth	The minimum depth of this part of the path from grade, in meters. This is mainly used for digging permits.	Real	Required for buried new installation or repair	SDS	
DATE_INST	The date the riser was installed. Format for date is YYYYMMDD (i.e., September 15, 1994 = 19940915).	Date (and Time if available) installed.	Integer(1)	Required for new installation or repair	SDS	
REMARKS	Descriptive Text	A description or other unique information concerning the subject item, unlimited length (SDSFIE export limited to first 240 characters).	Memo	Optional	SDS	
DISPOSTN_D	Disposition Code	The status of the subject	Char(16)	Required	SDS	D_DPOBJ

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
		item (e.g., permanent, temporary, proposed, abandoned, etc.), from lists or entered from field inspections.				
MAPSRC_D	Map Source Discriminator	DISCRIMINATOR - Used to indicate the source of data for the spatial position of this graphic. This is used for planning, and digging permits.	Char(16)	Required (Set default value to GPS_FLDLOC)	IUO	D_DATSRC
MAPACU	Spatial Accuracy in Meters	Describes the spatial accuracy of mapsrc_d. in meters, +/- of where the feature may actually be. For example, if you are using GPS and its only accurate to 1 meter, put a 1 in this field.	Real	Required	IUO	

**A.1.7 Covstrip (Riser)****Definition**

A pipe-like structure used for the vertical conveyance of cable.

**Geometry type**

Site (Point)

**Child features/tables**

Cohstcpn (Comm Path Node)

**Attributes**

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
HEIGHT	Height	The height of the riser duct measured from the ground surface to the top.	Real	Required for new installation or repair	SDS	
HEIGHT_U_D	Height Unit Measure Code	Height Unit of Measure.	Char(16)	Required for new installation or repair	SDS	D_UOMDIS
DIAMETER	Diameter	The width of a cylindrical or circular riser as measured from the ground surface to the top.	Real	Required for new installation or repair	SDS	

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
DIAM_U_D	Diameter Unit Measure Code	The diameter UOM.	Char(16)	Required for new installation or repair	SDS	D_UOMDIS
NARRATIVE	Descriptive Text	A description or other unique information concerning the subject item, unlimited length (SDSFIE export limited to first 240 characters).	Memo	Recommended	SDS	
MAT_D	Riser Material Code	The type of material the riser is made of.	Char(16)	Required	SDS	D_PIPMAT
DATE_INSTL	Installation Date	The date the riser was installed. Format for date is YYYYMMDD (i.e., September 15, 1994 = 19940915).	Integer(1)	Required for new installation or repair	SDS	
DUCT_D	Duct Indicator Code	A Boolean indicating the presence of a duct.(Y/N)	Char(16)	Required	SDS	D_BOOLEAN

**A.1.8 (Electronic Marker)****Definition**

Codevelm Device that aids location of buried communications equipment or pathways.

**Geometry type**

Point

**Attributes**

Column Name	SDSFIE Common Name	Description	SDSFIE Type	Use	Standard	Domain Table
TYPE_D	Marker Type Code	Discriminator References d_elmtyptable, indicating the type of marker.	Char(16)		SDS	D_ELMTYP
PASSVE_D	Passive Device Indicator Code	Discriminator References d_booleantable, Is it a passive device? (Y/N).	Char(16)		SDS	D_BOOLEAN
REMARKS	Descriptive Text	A description or other unique information concerning the subject item, unlimited length (SDSFIE export limited to first 240 characters).	Memo	Optional	SDS	
MAPSRC_D	Map Source Discriminator	DISCRIMINATOR - Used to indicate the source of data for the spatial position of this graphic. This is used for planning, and digging permits.	Char(16)	Required	IUO	
MAPACU	Spatial Accuracy in Meters	Describes the spatial accuracy of mapsrc_d. in meters, +/- of where the feature may actually be. For example,	Real	Required	IUO	

		if your using GPS and its only accurate to 1 meter, put a 1 in this field.				
--	--	--	--	--	--	--

## A.2 Domain Values for Attributes of Comm-Path Feature Entities

### A.2.1 *d\_coped: communications - pedestal type*

#### What it does

This table lists communications pedestal types.

#### Referenced by

COMM\_PEDESTAL

#### Attributes

Lookup Value	Long Description
PED12	12 inch pedestal
PED4	4 inch pedestal
PED6	6 inch pedestal
PED8	8 inch pedestal
TBD	To Be Determined
UNKNOWN	Unknown
OTHER	Other
CAD6	6 Inch
CAD10	10 Inch
CAD12	12 Inch
BD2	BD2
BD3	BD3
BD4	BD4
BD5	BD5
BD6	BD6
BD7	BD7
BD10	BD10
BD12	BD12
CAD	Controlled Access Distribution Closure
BD	Buried Distribution Closure
CAB	Cabinet enclosure, accessed through a hinged door
BOX	Rectangular box type enclosure, accessed by removing a cover panel

### A.2.2 *d\_coptht: communications - comm path type*

#### What it does

This table lists communications path types.

#### Referenced by

COMM\_PATH\_SEGMENT

#### Attributes

Lookup Value	Long Description
Duct	Single communications duct
Ductbank	A container for multiple ducts
Aerial	Above ground path between, poles, towers or buildings
Direct Bury	Below ground path where soil has direct contact with cable
Stub-Out	Short duct used with manholes and vaults

Cable Bridge	Bridge only used for cables
Cable Trough	Pathway on top of ground for cables
Riser	A vertical path for cables, usually on a building, pole, or tower

**A.2.3 d\_costrm (comm. - enclosure materials)****What it does**

This table lists the standard materials used in communication enclosures (manholes, vaults, pedestals, pullboxes, etc.)

**Referenced by**

COESTMHL (Manhole), COESTPED (Pedestal), COESTVLT (Vault) and COVSTRIP (Riser)

**Attributes**

Lookup Value	Long Description
AL	Aluminum
CIS	Concrete Cast inSitu/Cast in Place
COMBINATION	Combination of materials
FIBERGLASS	Fiberglass
IRON	Iron (Cast or Forged)
MASONRY	Masonry (Brick or Block)
OTHER	Other
PLASTIC	Plastic
PRECAST	Pre-Cast Concrete
STEEL	Steel
TBD	To Be Determined
UNKNOWN	Unknown

**A.2.4 d\_covtyp: type list - manhole cover****What it does**

This table lists communications manhole cover types.

**Referenced by**

COMM\_MANHOLE

**Attributes**

Lookup Value	Long Description
REC	Rectangular (24 inch by 36 inch)
RND24	Round (24 inch diameter)
RND27	Round (27 inch diameter)
RND28	Round (28 inch diameter)
RND30	Round (30 inch diameter)
RND36	Round (36 inch diameter)
RND38	Round (38 inch diameter)
RND42	Round (42 inch diameter)
RND48	Round (48 inch diameter)
UNKNOWN	Unknown
OTHER	Other
TBD	To Be Determined

## A.2.5 d\_datsrc: source list - data

**What it does**

Allowable input values for data sources.

**Referenced by**

COMM\_DBSPLICE, COMM\_MANHOLE, COMM\_PATH\_SEGMENT, COMM PEDESTAL, COMM\_PULLBOX, COMM\_VAULT

**Attributes**

Lookup Value	Long Description
RECORD_DWG	record drawing
AER_PHOTO	aerial photography
AER/FLD_SURVEY	aerial photography/field location survey
SHOP_DWG	shop drawings and shop notes
SHOP/SURVEY	shops and survey
OTHER_DWG	other drawings/data history file
ASBUILT_DWG	as-built drawing/shop
FLDLOC_SURVEY	field location survey
POLE_INV	pole inventory
GRND_PHOTO	ground photography
GPS_FLDLOC	input from GPS, field located and verified
AS_BUILT	as-built drawings
UNKNOWN	Unknown
OTHER	Other
TBD	to be determined
CSIR	Communications System Installation Record

## A.2.6 d\_dpobj: disposition list - object

**What it does**

Allowable input for the disposition of an object.

**Referenced by**

COMM\_DBSPLICE, COMM\_MANHOLE, COMM\_PATH\_SEGMENT, COMM PEDESTAL, COMM\_PULLBOX, COMM\_VAULT

**Attributes**

Lookup Value	Long Description
INCOMPLETE	incomplete or unfinished
UNKNOWN	Unknown
OTHER	Other
TBD	to be determined
ABANDONED	abandoned in place (not in use)
PERMANENT	Permanent
TEMPORARY	Temporary
PROPOSED	Proposed
BURIED	Buried
IN_SERVICE	In service and being used.
RETIRED	Permanently retired, or taken out of service.
COLLAPSED	An unserviceable item
UNKNOWN	Unknown

OTHER	Other
TBD	To Be Determined

**A.2.7 *d\_elmtyp: communications - electronic marker type*****What it does**

This table contains information about various communications electronic marker types.

**Referenced by**

COMM\_ELECTRONIC\_MARKER

**Attributes**

Lookup Value	Long Description
BALL	Ball Type
TAPE	Tape Type
UNKNOWN	Unknown
OTHER	Other

**A.2.8 *d\_mhfun: type list - manhole function*****What it does**

This table lists the function of manholes.

**Referenced by**

COMM\_MANHOLE

**Attributes**

Lookup Value	Long Description
COIL	slack – coil
SPL	Splice
T_SPL	T-splice
TBD	To Be Determined
OTHER	Other
UNKNOWN	Unknown

**A.2.9 *d\_mhtyp: type list - comm manhole*****What it does**

This table lists types of manholes.

**Referenced by**

COMM\_MANHOLE

**Attributes**

Lookup Value	Long Description
CEMH	Controlled Environment ManHole
HH_Type_A	Handhole Type A
J4	J4 Manhole
JC9C	JC9C (2450mm x 1750mm x 1450mm)
OTHER	Other
R2A	R2A Manhole
TBD	To Be Determined
UNKNOWN	Unknown
1T1	1T1



4T1	4T1
5T1	5T1
6T1	6T1
6T2	6T2
8T1	8T1
A	A Type
J3	J3 Manhole
L	L Manhole
T	T Manhole
V	V Manhole

**2.10 d\_pipmat: material list - pipe****What it does**

Allowable material values for pipe.

**Referenced by**

COMM\_RISER

**Attributes**

Lookup Value	Long Description
AL	Aluminum
ABS	acrylonitrile butadiene styrene
ASBESTCEMENT	asbestos cement
BLACK_FE	black iron
BRICK	brick
CEMENT	cement
CONCRETE	concrete
CORRUGATEDAL	corrugated Aluminum
CORRALBITMEN	corrugated Aluminum with bituminous coating
CORRALPAVINV	corrugated Aluminum with paved invert
CASTIRON	cast iron
CORR_METAL	corrugated metal
CORRMETLBITM	corrugated metal with bituminous coating
CORRMETPAVIN	corrugated metal with paved invert
CORR_STEEL	corrugated steel
CORRSTELBITM	corrugated steel with bituminous coating
CORRSTELPAVI	corrugated steel with paved invert
CU	Copper
COATWRAPSTEL	coated and wrapped steel
CRESOTEDWOOD	creosoted wood
DUCTILEFE	ductile iron
FIBER	fiber
FIBERGLASS	fiberglass

**A.2.11 d\_spcas (communications - splice case typ)****What it does**

This table lists types of splice cases.

**Referenced by**

COESTDBS (Dbsplice

Lookup Value	Long Description
FOSC_100_B_H	Raychem FOSC-100 B/H
OTHER	Other
TBD	To Be Determined
UCN_7_10	Siemens UCN 7-10
UC_6_9	Siemens UC 6-9
UNKNOWN	Unknown
12.5SS	12.5 Inch Stainless Steel
2_TYPE	2 Type
3BB	3 Inch Better Buried
3RS	3 Inch ReddiSeal
3SS	3 Inch Stainless Steel
4BB	4 Inch Better Buried
4RS	4 Inch ReddiSeal
4SS	4 Inch Stainless Steel
6.5BB	6.5 Inch Better Buried
6.5RS	6.5 Inch ReddiSeal
6.5SS	6.5 Inch Stainless Steel
9.5BB	9.5 Inch Better Buried
9.5RS	9.5 Inch ReddiSeal
9.5SS	9.5 Inch Stainless Steel
HS	Heat Shrinkable
KBV	K&B Vault
LEAD	Lead Tube
READY_ACCESS	Ready Access Aerial Terminal

**A2.12 d\_spmat (communications - splice case mat)****What it does**

This table lists types of materials used for communications splice cases.

**Referenced by**

COESTDBS (Dbsplice

Lookup Value	Long Description
OTHER	Other
TBD	To Be Determined
UNKNOWN	Unknown
EVA	EVA - Ethylene Vinyl Acetate (Heat Shrinkable Tubing)
PE	PE - Polyethylene
PP	PP - Polypropylene
AL	AL - Aluminum
FIBER	FIBER - Fiberglass
IRON	IRON - Cast Iron
LEAD	LEAD

PVC	PVC - PolyVinyl Chloride
SS	SS - Stainless Steel

**A.2.13 d\_tydrn: type list - drain****What it does**

Allowable input values for type of drains.

**Referenced by**

COMM\_MANHOLE

**Attributes**

Lookup Value	Long Description
FAN	fan
NETWORK	network
SEALED	sealed
SEEPAGEPIT	seepage pit
STORMCONNECT	connected to storm system
SUBDRAIN	sub drain (French drain)
SUMPPUMP	sump pump
TILEFIELD	tile field
OTHER	Other
TBD	To Be Determined

**A.2.14 d\_uomdis: discriminator – unit of measure (distance or length)****What it does**

This table lists allowable input values for units of measure (distance or length).

**Referenced by**

COMM\_DBSPICE, COMM\_MANHOLE, COMM\_PEDESTAL, COMM\_RISER, COMM\_VAULT

**Attributes**

Lookup Value	Long Description
CM	centimeters
DM	A unit of distance in the metric system equal to 1/10 of a meter.
EM	ems - 0.166667 inches
EN	ens - 0.083333 inches
FT	foot - 0.3048006 meters
IN	inches - 0.126263 links (Gunter) or 2.54 centimeters
INTERNATIONAL_FT	1 meter = 3.280839895 International feet
M	meters - 1.093614 yards or 39.3701 inches
US_SURVEY_FT	1 meter = 3.28083333 US survey feet
YD	yard - A unit of distance equal to 3 feet or 0.9144 meter.

Add/Alter Hangar Bay  
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Langley AFB, Virginia

## APPENDIX HH

### Photos of Existing Hangar Bays

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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## Existing Hangar Bay Elevation Photos



East Side



North Side

Ensure  
Watertable  
extends below  
grade

Tuesday, July 13, 2010

## Site of New Hangar Bay (South Side)



Note utilities  
under new  
site

Tuesday, July 13, 2010

## Hangar Bay Doors and Track



Door Track Detail





## Breathable Air and Compressed Air Connections in Hangar Bay



Add/Alter Hangar Bay  
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## APPENDIX II

NOT USED

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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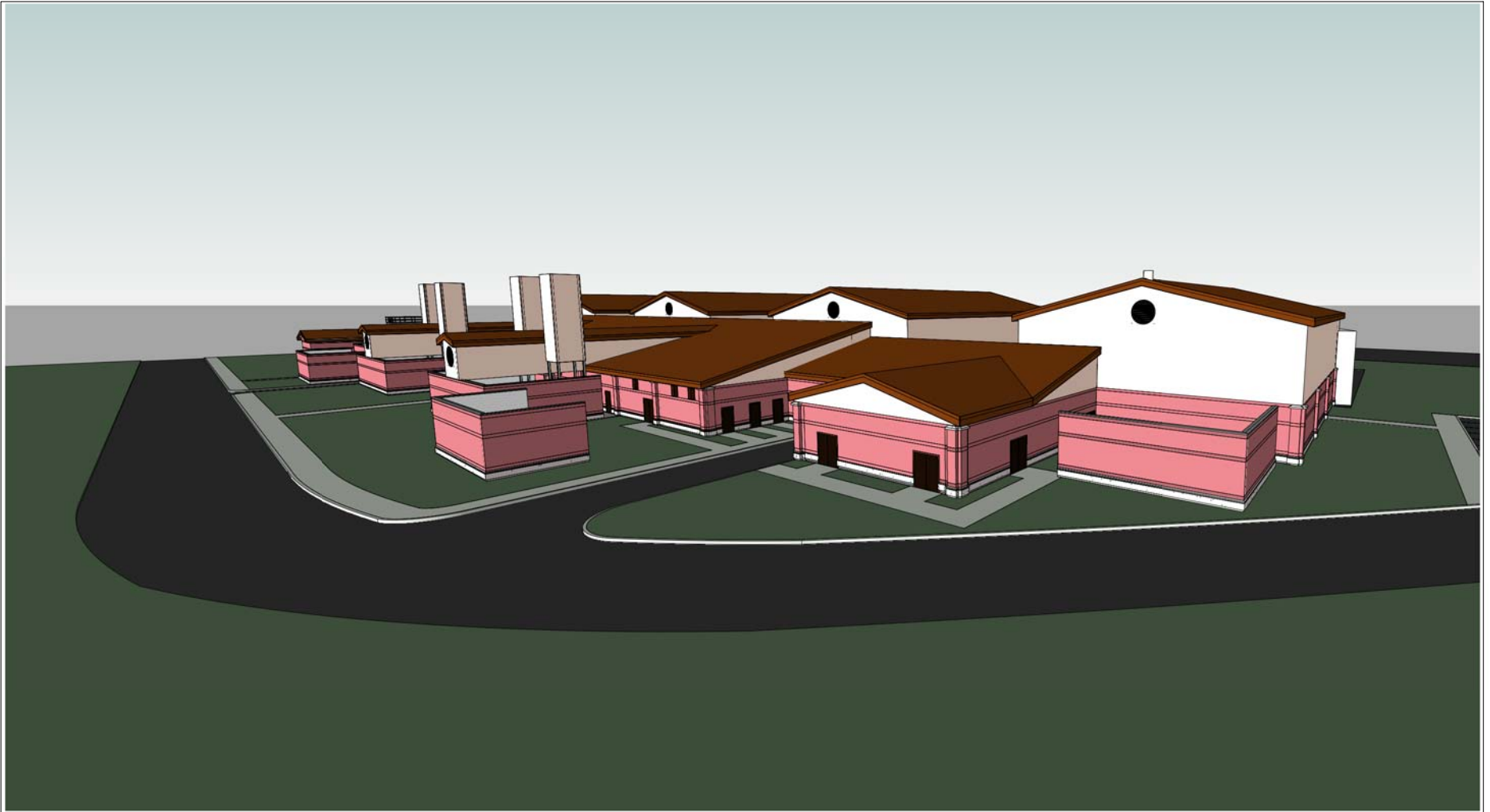
Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX JJ

### LO-CR Hangar Bay Perspectives

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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**LANGLEY AFB - F22 LOCR HANGAR**

*LAND SIDE PERSPECTIVE*

Section:



**LANGLEY AFB - F22 LOCR HANGAR**

*LAND SIDE PERSPECTIVE*

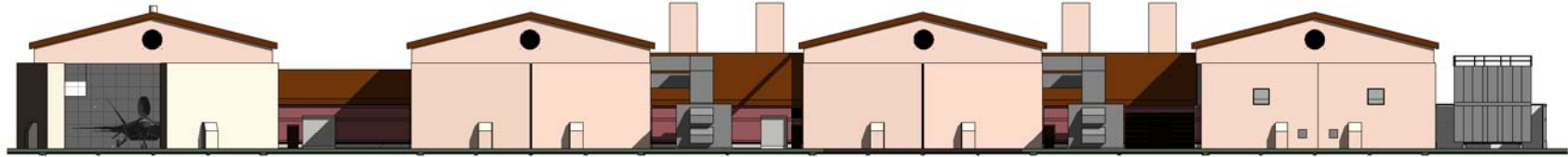


**LANGLEY AFB - F22 LOCR HANGAR**

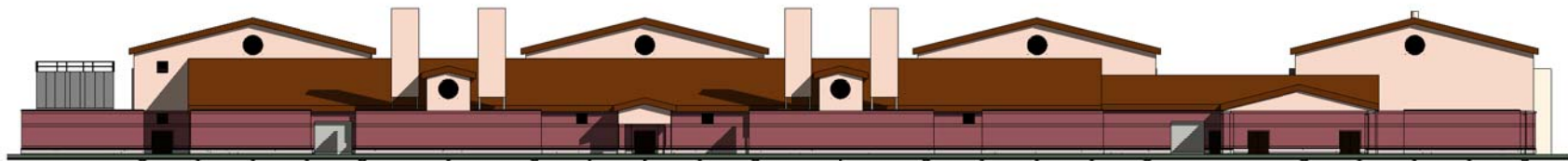
*AIR SIDE PERSPECTIVE*



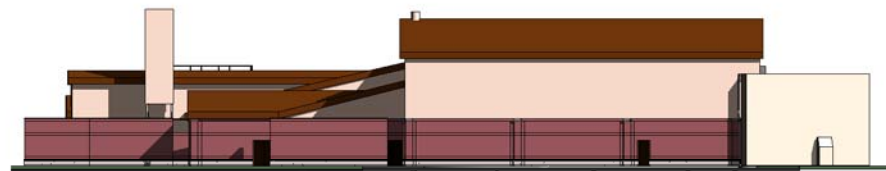
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EAST



WEST

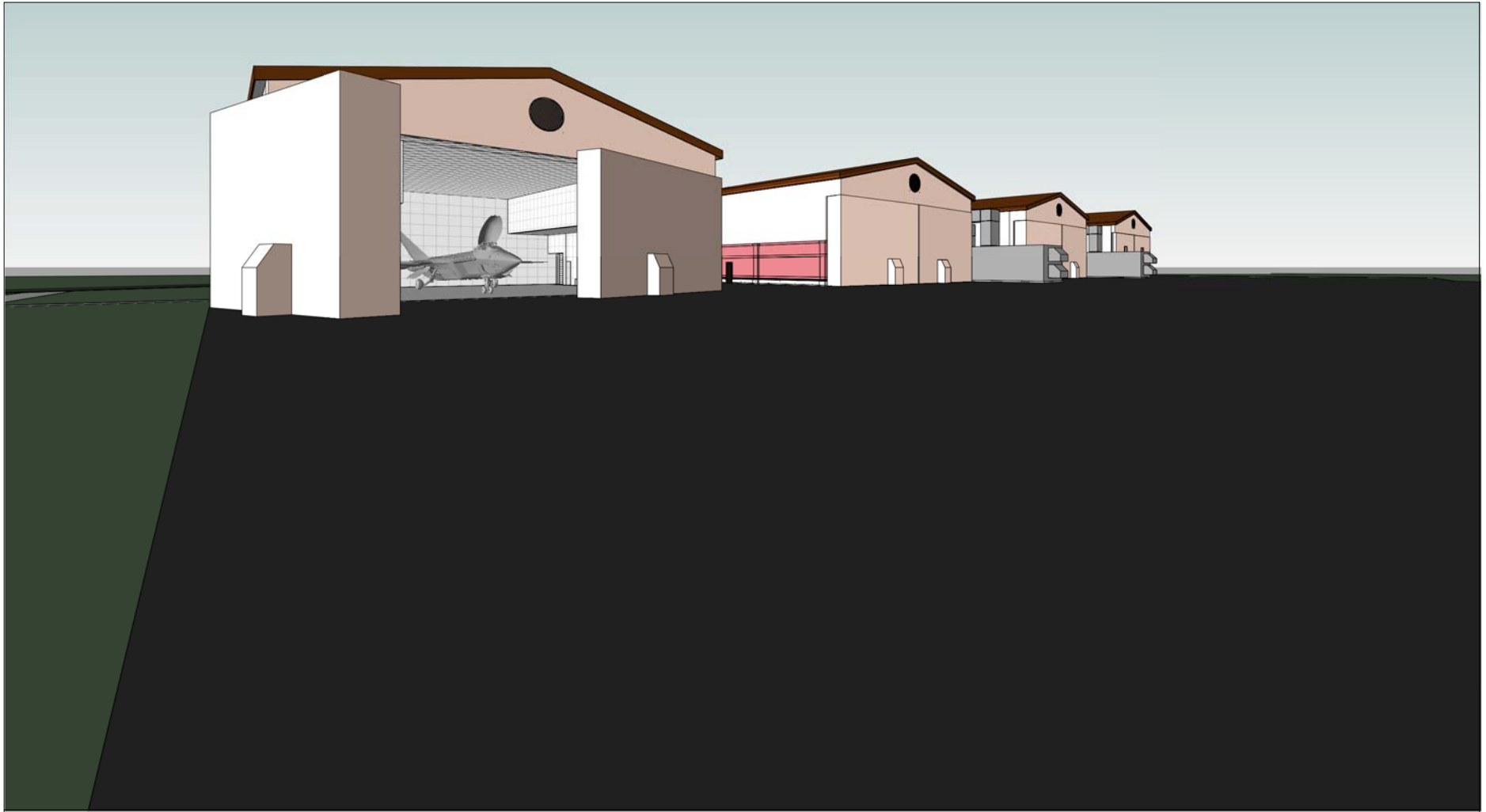


SOUTH

**LANGLEY AFB - F22 LOCR HANGAR**

*EXTERIOR ELEVATIONS*

Section:



**LANGLEY AFB - F22 LOCR HANGAR**

*AIR SIDE PERSPECTIVE*

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Langley AFB, Virginia

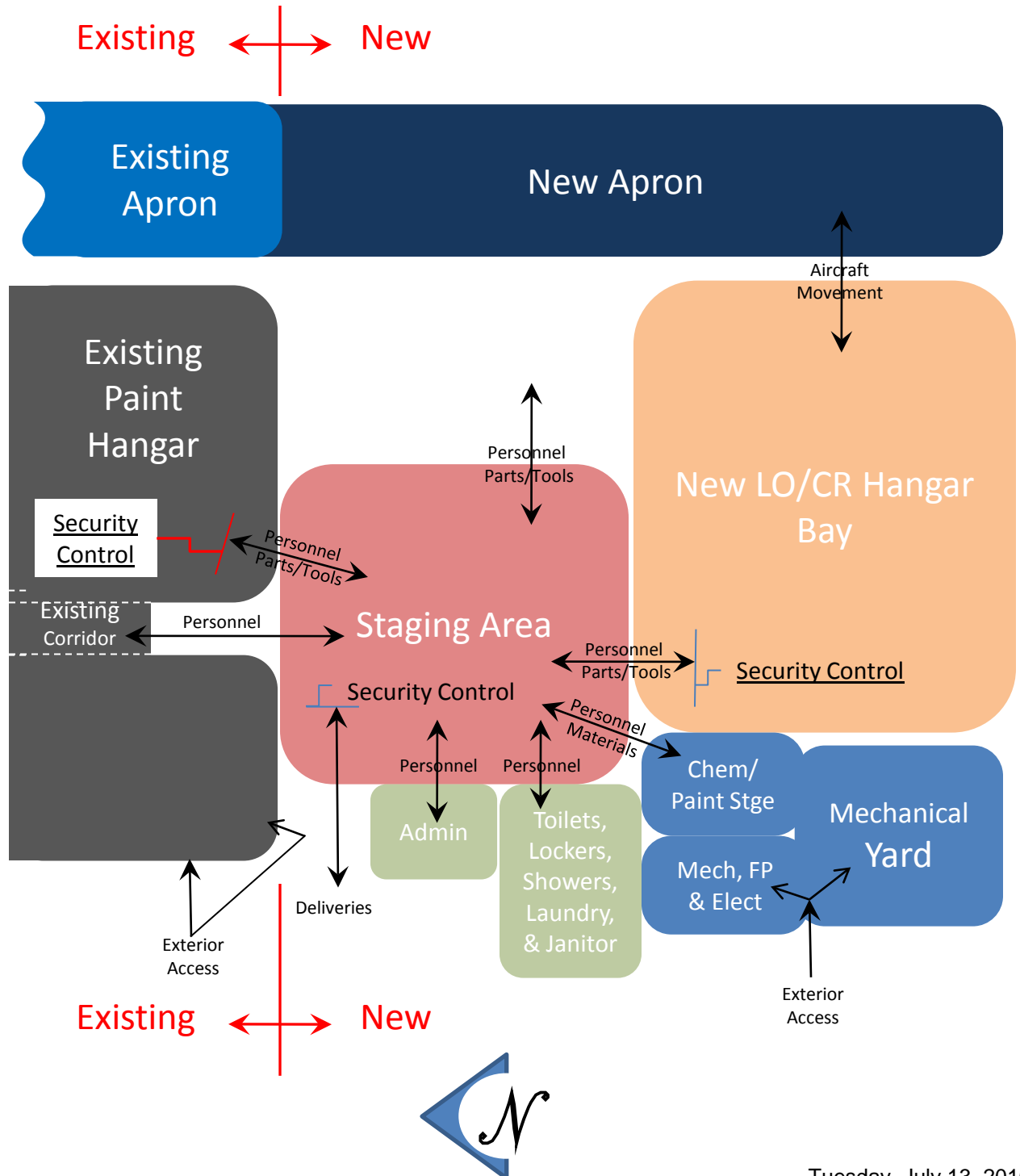
## APPENDIX KK

### Inter Relational Diagram

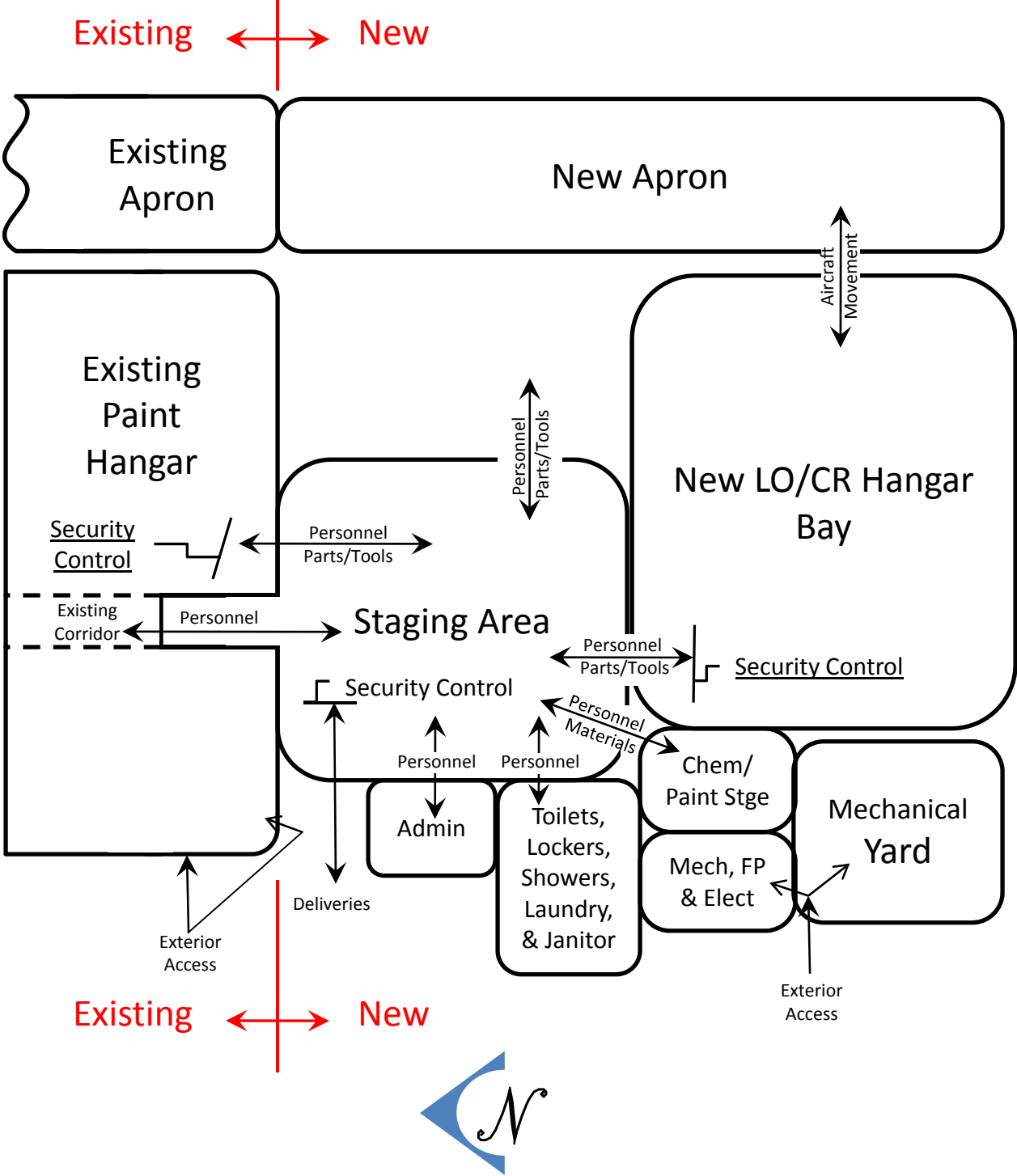
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# Inter-Relational Diagram or Bubble Diagram



Inter-Relational Diagram  
or  
Bubble Diagram



Add/Alter Hangar Bay  
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Langley AFB, Virginia

## APPENDIX LL

### Room Data Sheets



Add/Alter Hangar Bay  
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Langley AFB, Virginia

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F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** PAINT HANGAR  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	5333 SF (paint booth only)
	<b>Ceiling:</b>	Insulated metal panel. Height varies.
	<b>Doors:</b>	Plenum hangar doors; PB operated 10'x10' OHDR
	<b>Exterior Walls:</b>	P/C Concrete, Brick; Insulated metal panel
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Urethane floor coating
	<b>Other:</b>	Filter wall / plenum

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	None
	<b>Data:</b>	None
	<b>PA:</b>	White noise
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	70-75 degrees
	<b>Ventilation:</b>	
	<b>Air Conditioning:</b>	
	<b>Plumbing:</b>	Trench drain; EWSS w/ drain; stainless steel sink; hose bibb; compressed air; breathing air; vacuum line

<b>ELECTRICAL:</b>	<b>Lighting:</b>	Explosion proof; fluorescent
	<b>Power:</b>	6 dedicated 30A 120 V services
	<b>Hazardous Area:</b>	Class I, Div. 1
	<b>Security:</b>	Vault door for security
	<b>Special grounding:</b>	Grounding points for aircraft

<b>FIRE PROTECTION:</b>	HEF & sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
Equipment in Room	Owner		Contractor	
	Furnished	Installed	Furnished	Installed

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** STAGING AREA  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	3356 SF
	<b>Ceiling:</b>	12' ACT
	<b>Doors:</b>	(2) PB operated 10'x10' OHDR to exterior
	<b>Exterior Walls:</b>	P/C Concrete, Brick; Insulated metal panel
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Urethane floor coating
	<b>Other:</b>	

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	Yes
	<b>Data:</b>	None
	<b>PA:</b>	White noise
	<b>CCTV:</b>	At controlled entry to hangar
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	NSR
	<b>Plumbing:</b>	EWSS w/ drain

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	NSR
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** HAZARDOUS STORAGE  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	195 SF
	<b>Ceiling:</b>	Open to structure
	<b>Doors:</b>	Pair 3'x7'
	<b>Exterior Walls:</b>	P/C Concrete, Brick; Insulated metal panel
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Sealed concrete
	<b>Other:</b>	Depressed floor for containment; 2 hour fire separation

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	None
	<b>Data:</b>	None
	<b>PA:</b>	None
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	NSR
	<b>Plumbing:</b>	None

<b>ELECTRICAL:</b>	<b>Lighting:</b>	Explosion proof; fluorescent
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	Class I, Div. 2
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>
Metal shelving	X			X

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** PAINT STORAGE  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	203 SF
	<b>Ceiling:</b>	Open to structure
	<b>Doors:</b>	Pair 3'x7'
	<b>Exterior Walls:</b>	
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Sealed concrete
	<b>Other:</b>	Depressed floor for containment; 2 hour fire separation

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	None
	<b>Data:</b>	None
	<b>PA:</b>	None
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	NSR
	<b>Plumbing:</b>	None

<b>ELECTRICAL:</b>	<b>Lighting:</b>	Explosion proof; fluorescent
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	Class I, Div. 2
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>
Metal shelving	X			X

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** WOMEN'S LOCKER ROOM  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	178 SF
	<b>Ceiling:</b>	9' ACT
	<b>Doors:</b>	Standard
	<b>Exterior Walls:</b>	P/C Concrete, Brick; Insulated metal panel
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Porcelain tile
	<b>Other:</b>	

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	None
	<b>Data:</b>	None
	<b>PA:</b>	White noise
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	NSR
	<b>Plumbing:</b>	HC Shower

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>
15"Wx18"Dx72"H Lockers (20)			X	X

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** MEN'S LOCKER ROOM  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	178 SF
	<b>Ceiling:</b>	9' ACT
	<b>Doors:</b>	Standard
	<b>Exterior Walls:</b>	
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Porcelain tile
	<b>Other:</b>	

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	None
	<b>Data:</b>	None
	<b>PA:</b>	White noise
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	NSR
	<b>Plumbing:</b>	HC Shower

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>
15"Wx18"Dx72"H Lockers (20)			X	X

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** LAUNDRY  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	123 SF
	<b>Ceiling:</b>	9' ACT
	<b>Doors:</b>	Standard
	<b>Exterior Walls:</b>	P/C Concrete, Brick; Insulated metal panel
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Sealed Concrete
	<b>Other:</b>	

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	None
	<b>Data:</b>	None
	<b>PA:</b>	None
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	NSR
	<b>Plumbing:</b>	Floor drain; rough ins for equipment

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>
Respirator washer	X	X		
Clothes washer	X	X		
Clothes dryer	X	X		



F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** OPEN OFFICE  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	233 SF
	<b>Ceiling:</b>	9' ACT
	<b>Doors:</b>	Standard
	<b>Exterior Walls:</b>	
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Carpet tile
	<b>Other:</b>	

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	Yes
	<b>Data:</b>	Yes
	<b>PA:</b>	White noise
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	NSR
	<b>Plumbing:</b>	No

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>
(2) 8'x8' Work station	X	X		

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** JANITOR  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	58 SF
	<b>Ceiling:</b>	9' ACT
	<b>Doors:</b>	Standard
	<b>Exterior Walls:</b>	
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Sealed Concrete
	<b>Other:</b>	

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	None
	<b>Data:</b>	None
	<b>PA:</b>	None
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	NSR
	<b>Plumbing:</b>	Floor sink

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>
Mop rack; shelves			X	X

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** ELECTRICAL ROOM  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	212 SF
	<b>Ceiling:</b>	Open to structure
	<b>Doors:</b>	Pair 4'x8'
	<b>Exterior Walls:</b>	P/C Concrete, Brick; Insulated metal panel
	<b>Interior Walls:</b>	CMU
	<b>Floors:</b>	Sealed Concrete
	<b>Other:</b>	

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	Yes
	<b>Data:</b>	None
	<b>PA:</b>	None
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	No
	<b>Plumbing:</b>	NSR

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** HEF ROOM  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	277 SF
	<b>Ceiling:</b>	Open to structure
	<b>Doors:</b>	Pair 3'x7'
	<b>Exterior Walls:</b>	P/C Concrete, Brick; Insulated metal panel
	<b>Interior Walls:</b>	CMU
	<b>Floors:</b>	Sealed concrete
	<b>Other:</b>	Sump pit

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	Yes
	<b>Data:</b>	None
	<b>PA:</b>	None
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	No
	<b>Plumbing:</b>	Floor drain

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
-------------------------	------------------------

<b>ADDITIONAL REQUIREMENTS:</b>				
Equipment in Room	Owner		Contractor	
	Furnished	Installed	Furnished	Installed

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** MECHANICAL ROOM  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	358 SF
	<b>Ceiling:</b>	Open to structure
	<b>Doors:</b>	Pair 3'x7'
	<b>Exterior Walls:</b>	P/C Concrete, Brick; Insulated metal panel
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Sealed concrete
	<b>Other:</b>	

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	Yes
	<b>Data:</b>	Yes
	<b>PA:</b>	None
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	No
	<b>Plumbing:</b>	Floor drain

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>

F-22 ADD/ALTER HANGAR BAY LO/CR FACILITY  
LANGLEY AFB, VIRGINIA**ROOM DATA SHEET****ROOM TITLE:** UNISEX TOILET  
**ROOM NUMBER:**

<b>ARCHITECTURAL:</b>	<b>Size:</b>	52 SF
	<b>Ceiling:</b>	9' ACT
	<b>Doors:</b>	Standard
	<b>Exterior Walls:</b>	
	<b>Interior Walls:</b>	Painted CMU
	<b>Floors:</b>	Porcelain tile
	<b>Other:</b>	HC grab bars

<b>COMMUNICATIONS:</b>	<b>Telephone:</b>	None
	<b>Data:</b>	None
	<b>PA:</b>	White noise
	<b>CCTV:</b>	None
	<b>Other:</b>	

<b>MECHANICAL:</b>	<b>Heating:</b>	NSR
	<b>Ventilation:</b>	NSR
	<b>Air Conditioning:</b>	NSR
	<b>Plumbing:</b>	Lavatory; water closet

<b>ELECTRICAL:</b>	<b>Lighting:</b>	NSR
	<b>Power:</b>	NSR
	<b>Hazardous Area:</b>	No
	<b>Security:</b>	None
	<b>Special grounding:</b>	None

<b>FIRE PROTECTION:</b>	Sprinklers; Fire alarm
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<b>ADDITIONAL REQUIREMENTS:</b>				
<b>Equipment in Room</b>	<b>Owner</b>		<b>Contractor</b>	
	<b>Furnished</b>	<b>Installed</b>	<b>Furnished</b>	<b>Installed</b>
Mirror; soap dispenser; waste receptacle; paper towel dispenser; toilet paper holder			X	X

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Add/Alter Hangar Bay  
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Langley AFB, Virginia

## APPENDIX MM

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Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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## APPENDIX NN

### Langley Air Force Base Low Impact Design Handbook

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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# Langley Air Force Base

## Low Impact Design Handbook



Prepared By:

April 2010



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## Handbook Content

### **Section 1: Low Impact Design Introduction**

### **Section 2: LID Process and Implementation**

- LID Process Overview
- Pre-Development Hydrology
- Modeling Overview

### **Section 3: Design Considerations**

- Langley Plant Recommendations
- Soil Amendments

### **Section 4: LID Technologies**

### **Section 5: Langley AFB Site Design Case Study**

### **Appendix A: Acronyms and References**

### **Appendix B: Curve Number Table**

### **Appendix C: LID Cost Table**

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## SECTION 1 – LOW IMPACT DESIGN INTRODUCTION

### Low Impact Development

*Low Impact Development (LID) is a design strategy with the goal of maintaining or replicating the pre-development hydrologic regime through the use of design techniques to create a functionally equivalent hydrologic site design. Hydrologic functions of storage, infiltration and ground water recharge, as well as the volume and frequency of discharges are maintained through the use of integrated and distributed micro-scale stormwater retention and detention areas, reduction of impervious surfaces, and the lengthening of runoff flow paths and flow time. Other strategies include the preservation/protection of environmentally sensitive site features such as riparian buffers, wetlands, steep slopes, valuable (mature) trees, flood plains, woodlands, and highly permeable soils. (Virginia's LID Assessment Task Force, 2005).*





### Purpose of the Langley LID Design Handbook

To provide information regarding the implementation of LID technologies and strategies aligned with the US Air Force and Langley Air Force Base (AFB) specific needs. This handbook should be used in the design and planning phase of projects to incorporate LID technologies that are relevant and applicable to Langley AFB. The recommendations in this handbook can also be used when retrofitting existing structures.

The implementation of LID technologies at Langley AFB are beneficial across the board to improve the quality of stormwater runoff; therefore, being protective of human health and the environment. These technologies improve the ability for Langley to comply with Virginia stormwater management regulations, erosion sediment control regulations, and the Chesapeake Bay Preservation Act. Additionally, as the focus on total maximum daily loading (TMDL) increases, implementing these technologies will reduce pollutant loadings to the sensitive habitats surrounding Langley AFB.



#### *Benefits of LID implementation at Langley AFB:*

- *Improve water quality of  
stormwater runoff;*
- *Be protective of human health  
and the environment.*

## Applicable Federal Policies

### **Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance\***

- Executive Order (E.O.) 13514 requires EPA, in coordination with other federal agencies as appropriate, to issue guidance on the implementation of Section 438 of the Energy Independence and Security Act of 2007 (EISA). EPA's Office of Water coordinated the development of these guidelines.

### **Energy Independence Security Act of 2007 (EISA)\***

- Section 438 of EISA requires federal agencies to maintain or restore the predevelopment hydrology (the runoff volume, rate, temperature, and duration of flow that typically existed on the site before human-induced land disturbance occurred) of the site of any project with a footprint that exceeds 5,000 square feet.

### **Executive Order 13423\***

- E.O. 13423, issued in January 2007, requires federal agencies to implement the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings in all new construction and major renovation projects and in at least 15 percent of their existing building inventories by the end of FY 2015.

### **Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding (MOU)\***

- In January 2006, U.S. Environmental Protection Agency (EPA) signed an MOU with 16 other federal agencies to promote high performance and sustainable buildings. On 1 December 2008, the Interagency Sustainability Working Group released a High Performance and Sustainable Buildings Guidance document that updated the MOU Guiding Principles and established Guiding Principles for Sustainable Existing Buildings.
- The Guiding Principles, which incorporate requirements from EISA, require agencies to employ design and construction strategies that reduce stormwater runoff, polluted site water runoff, and the use of potable water for irrigation. They promote the use of decentralized stormwater management design strategies to maintain or restore site hydrology to pre-development conditions and promote water-efficient landscaping and irrigation strategies.

\*Summary source : <http://www.epa.gov/greeningepa/stormwater/requirements.htm>

## Applicable DoD Policies

### Unified Facilities Criteria (UFC)

- The UFC system provides planning, design, construction, sustainment, restoration, and modernization criteria applicable to all military departments, the Defense Agencies, and the DoD Field activities. The UFC will be used for all DoD projects .

### Air Force Sustainable Design and Development (SDD) Policy

- The SDD policy objective is to implement sustainable development concepts in planning, design, and construction and operations of facilities and infrastructure by implementing design to reduce the environmental impact, improve energy efficiency and water conservation, and provide safe, healthy, and productive built environments while keeping costs at a minimum.

## LID Resources

### US Environmental Protection Agency LID Webpage

- <http://www.epa.gov/nps/lid/>
- Provides numerous resources for design, planning, and managing LID technologies.

### Low Impact Development Design Strategies

- <http://www.epa.gov/owow/nps/lid/lidnatl.pdf>
- The Prince George's County, Maryland LID design manual provides detailed information on site planning, hydrology, LID technologies, erosion and sediment control, and public outreach.

### Virginia's LID Task Force Technical Bulletin

- <http://www.valleyconservation.org/LID.html>
- Provides state specific requirements and recommendations for implementing LID design strategies.

SECTION 2: LID PROCESS and IMPLEMENTATION

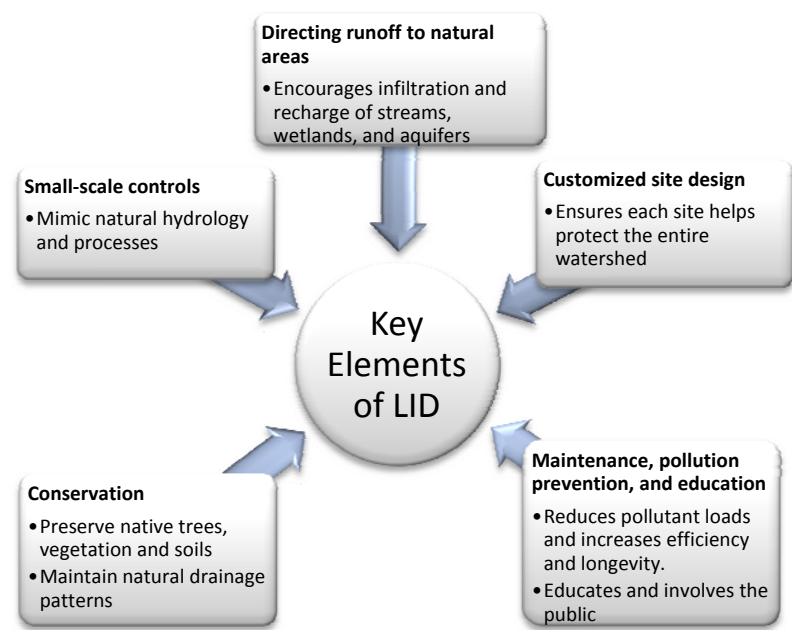


Figure 2-1: Key Elements of LID (Source: DoD, 2004)

LID site designs are aimed at implementing small-scale controls at a site level to maintain natural hydrologic function post-development. Ideally these individualized technologies maximize the existing natural

*The goal of the Langley AFB specific LID handbook is to demonstrate installation specific methods to reduce the hydrologic impact of development and to incorporate the techniques that maintain or restore the site's hydrologic function.*

resources in order to reduce stormwater sheet flow, reduce contaminants to open water bodies, and facilitate infiltration.

The goal of the Langley AFB specific LID handbook is to demonstrate installation specific methods to

reduce the hydrologic impact of development and to incorporate the techniques that maintain or restore the site's hydrologic function. Langley AFB poses specific challenges in managing stormwater such as compliance with Langley AFB Stormwater Pollution Prevention Plan (SWPPP), TMDL guidelines, and the Chesapeake Bay Preservation Act (CBPA). In addition logistical challenges at Langley AFB, such as a high-water table and Bird Aircraft Strike Hazard (BASH) dictate site design strategies and implementation.

Successful LID implementation is achieved by:

- Maintaining the pre-development site discharge volume;
- Maintaining the pre-development time of concentration ( $T_c$ ); and
- Minimizing the change in the runoff curve number (CN).

Figure 2-2 outlines the steps the planner/designer follows through the process to implement LID technologies in site designs. The follow-on sections provide background on steps 1 and 3.

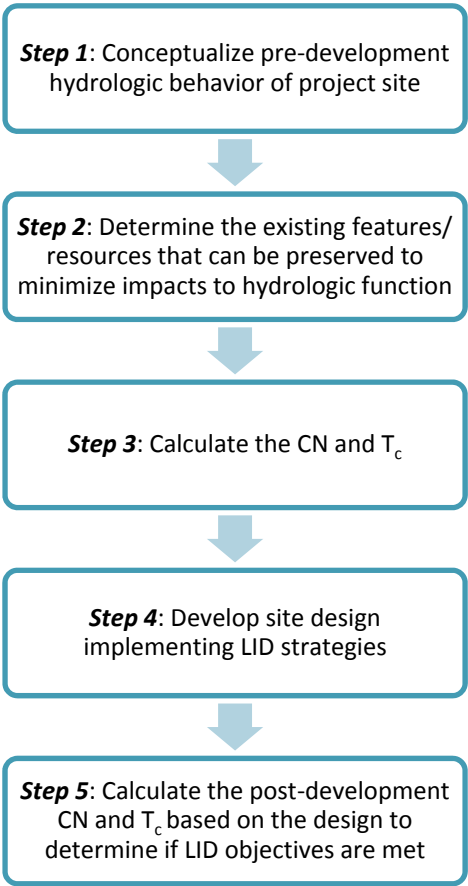


Figure 2-2: LID implementation process.

2.1 Pre-development Hydrology

**Step 1:** Conceptualize pre-development hydrologic behavior of project site

Every aspect of the hydrologic cycle (Figure 2-3) affects LID management decisions. The effects of the hydrologic cycle should be understood as they apply to the particular site; however, the response to rainfall is the controlling factor. Mathematical modeling of the rainfall behavior at a specific site is the accepted method to quantify and describe the behavior. Mathematical modeling can be performed analytically (solving the representative equations by hand) or numerically (solving the representative equations with a computer).

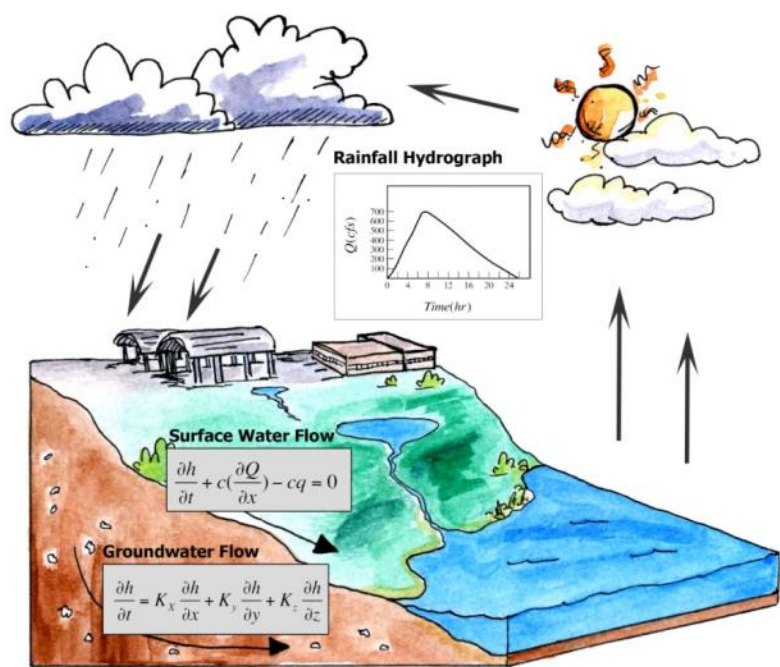


Figure 2-3: Depiction of the hydrologic process.

## 2.2 Modeling Overview

**Step 3:** Calculate the curve number (CN) and time of concentration ( $T_c$ )

To determine if the hydrologic function of the design is mimicking the pre-development hydrology the CN and  $T_c$  is compared.

Two of the most popular models for generating rainfall hydrographs (depictions of discharge versus time) are the US Environmental Protection Agency (EPA) Stormwater Management Model (SWMM) and the Natural Resources Conservation Service (NRCS) WinTR-55 (TR-55).

- SWMM - a dynamic rainfall-runoff simulation model used for single event or long-term simulation of runoff quantity and quality from primarily urban areas ([USEPA, July 2009](#)).
- TR-55 - a single-event rainfall-runoff, small watershed hydrologic model. The model generates hydrographs from both urban and agricultural areas. ([NRCS, January 2009](#)).

TR-55 is one of the models of choice for LID-related rainfall management and control decisions. The minimum data requirements for the TR-55 program are provided in Table 2-1. A case study is provided in Section 4 that works through the LID implementation process as outlined in Figure 2-1.

The Windows version of TR-55 may be downloaded from the following website:

[http://www.wsi.nrcs.usda.gov/products/w2q/h&h/tools\\_models/wintr55.html](http://www.wsi.nrcs.usda.gov/products/w2q/h&h/tools_models/wintr55.html).



**Table 2-1. Data Requirements for TR-55.**

Description	Comment
<b>Dimensionless Unit Hydrograph</b>	Provided by TR-55
<b>Storm Data Source</b>	Provided by TR-55
<b>Rainfall Distribution Identifier</b>	Provided by TR-55
<b>Sub-Area Name</b>	User Defined
<b>Sub-Area Description</b>	User Defined
<b>Sub-Area Discharge Type</b>	User Defined
<b>Area</b>	User Defined
<b>Weighted CN</b>	User Defined (using table in section 4.2)
<b>T<sub>c</sub></b>	Calculated by TR-55

Figure 2-4 shows a sample watershed schematic. The dotted line outlines the area of a watershed with multiple sub-areas. Sometimes it is necessary to divide a watershed into subareas because flow to the watershed outlet may be comprised of many contributors with varying durations and volumes. In the figure, the subareas are depicted by the Roman numerals. Watersheds that are larger than a single lot typically have more than one reach contributing to the flow at the outlet. The schematic depicts the conceptual physical division of the watershed which translates directly into the model input.

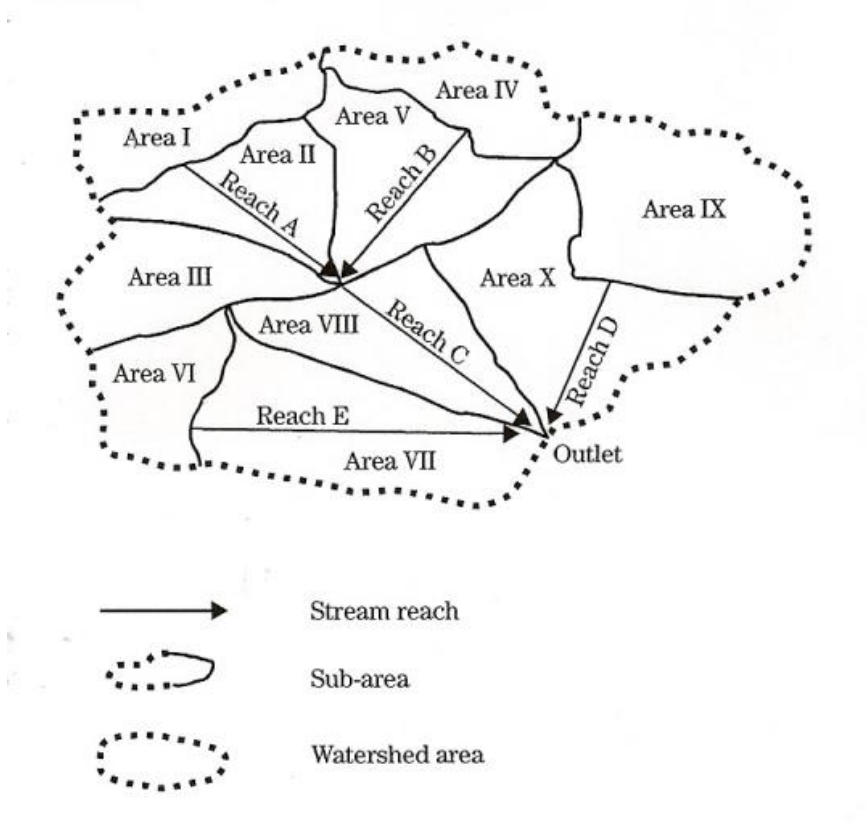


Figure 2-4: Sample watershed schematic' Source: NRCS 2009.

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Section 3: Design Considerations

The objective of this manual is to create valid recommendations for implementing LID at Langley AFB. In addition to assessing LID technologies and developing an installation specific case study for LID implementation, other design considerations must also be made. For example, the following sections detail plant recommendations specific to Langley’s location and climate for use in designing rain gardens or other features that require revegetation. This list and the recommended grasses list consider the BASH requirements for plantings that protects the flight mission of Langley AFB.

3.1 Langley Plant Recommendations

Site specific conditions determine what species are best suited for planting. The Table 3.1 lists a number of native species that are considered good choices for LID technologies requiring a landscaping element such as rain gardens, filter strips, and restored wetlands at Langley AFB. As this list was developed specifically for site conditions at Langley AFB, the list is limited. Species would need to be customized for conditions based upon proximity to any brackish or salt water, or potential for over wash, light conditions etc.



Rain garden used to capture stormwater runoff.  
Source:<http://www.ci.minneapolis.mn.us/stormwater/green-initiatives/rain-garden.asp>

Species selected for planting at  
Langley AFB should consider:

Design needs,  
Light conditions,  
Soil conditions,  
Salt tolerance.

**Table 3.1: Recommended plantings for Langley AFB LID technologies.**

Species	Mature size (height/ width in ft)	Inundation tolerance	Sunlight/shade tolerance
<i>Celtis occidentalis</i>	30-50/25-40	Seasonal	Partial shade/sun
<i>Nyssa sylvatica</i> *	varying	Seasonal	Sun
<i>Quercus falcata</i>	70/50	Temporary	Sun
<i>Quercus michauxii</i>	80/30-40	Seasonal	Partial shade/sun
<i>Quercus nigra</i>	70/45	Seasonal	Partial shade
<i>Quercus palustris</i>	50-90/50	Seasonal	Partial shade/sun
<i>Quercus phellos</i>	50-90/30-40	Seasonal	Partial shade/sun
<i>Salix nigra</i>	30-50/25	Seasonal	Sun
<i>Taxodium distichum</i>	60-100/30-50	Seasonal	Partial shade/sun
<i>Tilia americana</i>	60/40	Temporary	Partial shade/sun
<i>Quercus virginiana</i>	40-80/60-100	Temporary	Partial shade/sun
<i>Amelanchier arborea</i>	20-30/12-15	Temporary	Partial shade/sun
<i>Cercis canadensis</i>	20-30/25-35	Temporary	Partial shade/sun
<i>Chionanthus virginicus</i> *	varying	Temporary	Partial shade/sun
<i>Cornus florida</i>	15-30/12-20	Temporary	Partial shade/sun
<i>Diospyros virginiana</i>	30	Temporary	Partial shade/sun
<i>Ostrya virginiana</i>	40/25	Seasonal	Sun
<i>Sassafras albidum</i>	40/25	Temporary	Partial shade/sun
<i>Baccharis halimifolia</i>	9/5	Seasonal	Partial shade/sun
<i>Cephalanthus occidentalis</i>	6-9/10	Seasonal	Sun
<i>Hamamelis virginiana</i>	10/10	Temporary	Shade
<i>Lindera benzoin</i>	12-25	Seasonal	Shade
<i>Ilex sp.</i> *	varying	Temporary/ seasonal	
<i>Myrica cerifera</i>	12/15	Seasonal	Partial shade/sun
<i>Rhododendron viscosum</i>	6/4	Seasonal	Part sun

<i>Species</i>	Mature size (height/ width in ft)	Inundation tolerance	Sunlight/shade tolerance
<b><i>Monarda didyma</i></b>	3-5	Temporary	Shade/part sun
<b><i>Osmunda cinnamomea</i></b>	3-4/3	Seasonal	Shade/part sun
<b><i>Rudbeckia hirta</i></b>	3	Temporary	Sun
<b><i>Polystichum acrostichoides</i></b>	2/2-3	Seasonal	Shade/part sun
<b><i>Magnolia virginiana</i>*</b>	varying	Seasonal	Shade/part sun

\* Cultivars of these species are available in a range of sizes to accommodate various sized spaces for these applications.

**Grasses:** Additionally, per the LAFB BASH Plan, seeding applications should contain 100% high fungal endophytes, tall fescue species or a 40% bermuda - 60% tall fescue mix.

#### Resources for native species:

##### **Pinelands Nursery**

8877 Richmond Rd  
Toano, VA 23168  
(757) 566-3620  
<http://www.pinelandsnursery.com/>

##### **Environmental Concern**

P.O. Box P, 201 Boundary Lane  
St. Michaels, MD 21663  
(410) 746-9620  
[http://www.wetland.org/nursery\\_home.htm](http://www.wetland.org/nursery_home.htm)

##### **Knotts Neck Creek Nursery**

6120 Knotts Neck Road  
Suffolk, VA 23435-1929  
(757) 483-6383

### 3.2 Soil Amendments

Infiltration technologies, such as rain gardens, may require soil amendments to improve infiltration capacity. It is critical that the soil amendment guidelines be followed to ensure that the best management practice (BMP) will function as intended. Since varying soils are present at Langley AFB it is recommended that soils be evaluated as part of the assessment of pre-development hydrology at the site. Checking pH and infiltration rates are part of the method to determine what soil amendments may be needed to improve drainage.

*It is critical that the soil amendment guidelines be followed to ensure that the best management practice (BMP) will function as intended.*

General guidelines for amending soils specifically for rain gardens include placing up to three feet of a 50% sand, 30% top soil and 20% organic matter mixture in the basin to allow appropriate depth for root expansion and moisture retention. For soils with high clay content, it may be beneficial to remove approximately 1-2 feet of the existing soil and replace it with a more suitable soil. The mix should contain no more than 10% clay. If soils are being purchased avoid sterile soils.

Excavations should not go to groundwater depth and should generally allow for about six inches of retention. Unless you intend to create a wetland rain garden, it is not recommended to excavate to groundwater level. Groundwater depth issues at Langley may pose a challenge and limit the site selection for specific infiltration technologies.

## Section 4: LID technologies

LID technologies provide benefits such as decreasing peak flow, treating surface water for pollution prevention purposes, and reduction of infrastructure costs. LID technologies were assessed by a roundtable of participants that reviewed the efficacy of these technologies on Langley AFB.

LID technologies from the UFC were discussed during a roundtable meeting at Langley AFB to determine if each would be an appropriate fit considering Langley's specific needs and design limitations. Participants in the meeting included design and planning, pavements and grounds, real property, and stormwater management. This team was able to provide Langley-specific insight on the recommendations provided in this manual.

Below are general descriptions of technology design/practice groups and specific technology pages depicting the recommended technologies for Langley AFB.

**Infiltration Designs:** Engineered structures or landscape features designed to capture and infiltrate runoff. Main components of infiltration designs are:

- Reduction of runoff volume discharged from the site
- Reduction of infrastructure
- Improvements in water quality

Examples: bioretention, dry wells, filter strips, infiltration trench, permeable pavement/pavers, and vegetated buffers.

**Runoff Storage Practices:** Capturing stormwater runoff for reuse or gradual infiltration, evaporation or irrigation. Main components of runoff storage practices are:

- Reduction of discharge to surface waters
- Reduces erosion by reducing high-flow runoff



- Aesthetic addition to landscaping
- Reuse of runoff water for irrigation

Examples: cisterns and rain barrels.

**Runoff Conveyance Practices:** Systems designed to route excess runoff through and off site. Often used as an alternative to curb-and-gutter systems. Main advantages of conveyance designs are:

- Reduced discharge velocity and delay peak flows
- Alleviate on-site flooding
- Reduces sediment discharge to water bodies
- Aesthetic addition to landscaping

Examples: grassed swales, filter strips, tree box filters.

**Filtration Practices:** The filtering of runoff to capture pollutants, solids and/or exchange of dissolved pollutants. Filtration practices can be used to minimize the impact of polluted runoff waters from reach discharge locations, specifically “hot spots” (areas where higher concentrations of pollutants are more likely to occur). Hot spots are identified during the pre-development assessment of a site. The benefits to filtration practices include;

- Reduction in runoff volume
- Pollution prevention benefits

Examples: bioretention, dry wells, grassed swales, filter strips, tree boxes.

**Table 4.1: Summary of LID Technology Recommendations**

Technology	Recommended at Langley	Recommended with considerations	Not recommended	Pg
Bioretention	✓			21
Grassed Swale	✓			23
Filter Strip	✓			25
Permeable Pavers	✓			27
Soil Amendments	✓			29
Trash Racks	✓			31
Vegetated Buffer	✓			33
Rain Barrels		✓		35
Cisterns		✓		35
Tree Box Filter		✓		37
Dry Wells			✓	39
Infiltration Trench			✓	41
Inlet Protection Devices			✓	43
Permeable Pavement			✓	45
Reforestation			✓	47

\* Table 4.1 identifies ID technologies that are recommended to be used at Langley in green; those technologies that are recommended only when other factors are taken into consideration in orange; and those that are not recommended for use at Langley in red. This color coding is carried through to the technology page recommendation sections.

## BIORETENTION



Source:

<http://www.ia.nrcs.usda.gov/features/urbanphotos.html>

*Description:* Practice to manage and treat stormwater runoff by using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression. Dry ponds and rain gardens are examples of bioretention features that are currently implemented at Langley AFB.

*Application:* Commonly used to treat runoff from impervious areas, such as parking lots and commercial areas. For example, the bioretention features behind the Logistics Support Center at Langley AFB service the adjacent parking lot and roof runoff.

*Advantage:* Provides stormwater treatment that enhances the quality of downstream water bodies while providing shade and wind breaks, absorbing noise and improving an area's landscape.

*Disadvantage:* A minimum of six feet is required between ground surface and the ground water table limiting the locations on Langley AFB where these can be implemented.

*Maintenance requirements:* The primary maintenance requirement for bioretention cells (rain gardens) is that of inspection and repair or replacement of the treatment area's components. Generally, this involves the routine periodic maintenance that is required of any landscaped area. Maintenance tasks may include removal of sediment and debris, replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures

*Other information:* BASH must be considered in the design of bioretention features. These areas can be designed with public access in mind. The need for soil amendment should be assessed in the

development of the pre-development hydrology model as discussed in section 3.2.

*Cost Benefit Analysis of initial construction:* Soil amendments may be required with the design and should be considered in the cost analysis of the design.

*LEED Certification Points:*

Sustainable Sites Credits:

- Credit 6.2: Stormwater Design: Quality Control = 1 point

Water Efficiency Credits:

- Credit 1.1: Water Efficient Landscaping – 1 Point

*Other Resources:*

Virginia Department of Conservation and Recreation (DCR). *Virginia Stormwater Management Handbook*. 1999.

[http://www.dcr.virginia.gov/soil\\_and\\_water/documents/Chapter\\_3-11.pdf](http://www.dcr.virginia.gov/soil_and_water/documents/Chapter_3-11.pdf)

LakeSuperiorStreams. 2009. *LakeSuperiorStreams: Community Partnerships For Understanding Water Quality and Stormwater Impacts at the Head of the Great Lakes*.

<http://www.duluthstreams.org/stormwater/toolkit/raingarden.html>

Low Impact Design Center, Inc. 1999. *Urban Design Tools*.

[http://www.lid-stormwater.net/bio\\_benefits.htm](http://www.lid-stormwater.net/bio_benefits.htm)

California Stormwater Quality Association. 2003. *California Stormwater BMP Handbook*.

<http://www.cabmphandbooks.com/Documents/Industrial/TC-32.pdf>

*Recommendation:* Highly recommended for use at Langley AFB, dependant on availability of sufficient land area and water table depth.

## GRASSED SWALE



**SOURCE:**  
<http://www.richmondregional.org/Planning/Stormwater/chascity.htm>

**Description:** Shallow grass-covered hydraulic conveyance that helps to slow runoff and facilitate infiltration.

**Application:** Commonly used alongside roadways and right-of-ways to provide water quality and quantity control of stormwater runoff.

**Advantage:** Mimics natural hydrology on site. Trap and

remove sediments and other pollutants improving water quality.

**Disadvantage:** Not suitable on sites greater than 10 acres in size, or on slopes greater than 5%.

**Maintenance requirements:** Maintenance requirements include periodic mowing and annual visual inspections to assess and correct any sedimentation or erosion.

**Other information:** This technology is currently implemented at Langley AFB. A list of BASH recommended grasses is provided in Section 3.1. The need for soil amendment should be assessed in the development of the pre-development hydrology model.

**Cost Benefit Analysis of initial construction:** Construction and maintenance costs are significantly less than traditional curb and gutter systems.

### *LEED Certification Points:*

Sustainable Sites Credits:

- Credit 6.1: Stormwater Design: Quality Control = 1 point
- Credit 6.2: Stormwater Design: Quantity Control = 1 point

*Other Resources:*

Virginia DCR. 1999. *Virginia Stormwater Management Handbook*.  
[http://www.dcr.virginia.gov/soil\\_and\\_water/documents/Chapter\\_3-13.pdf](http://www.dcr.virginia.gov/soil_and_water/documents/Chapter_3-13.pdf)

Fairfax County. 2005. LID Fact Sheet, Water Quality Swale.  
[http://www.lowimpactdevelopment.org/ffxcty/2-7\\_waterqualityswale\\_draft.pdf](http://www.lowimpactdevelopment.org/ffxcty/2-7_waterqualityswale_draft.pdf)

LakeSuperiorStreams. 2009. *LakeSuperiorStreams: Community Partnerships For Understanding Water Quality and Stormwater Impacts at the Head of the Great Lakes*.  
<http://www.duluthstreams.org/stormwater/toolkit/swales.html>

California Stormwater Quality Association. 2003. *California Stormwater BMP Handbook*.  
<http://www.cabmphandbooks.com/Documents/Industrial/TC-30.pdf>

*Recommendation:* Highly recommended for future design and planning at Langley AFB as a low cost alternative to traditional curb and gutter systems.

## FILTER STRIP



Filter strip installed at the parking lot behind building Logistics Supply Center at Langley AFB.

***Description:*** Bands of close-growing vegetation, such as grass, planted between a pollutant source and a downstream receiving water body.

***Application:*** Commonly used as an outlet or pretreatment device for other stormwater control practices.

***Advantage:*** Mimics natural hydrology.

***Disadvantage:*** Drainage area limitations of 150 feet for pervious surfaces and 75 feet for impervious surfaces.

***Maintenance requirements:***

Minimal maintenance is required, periodic removal of sediment at inlets is on an as needed basis. If inlets are kept free of sediment and debris, these structures require no additional maintenance.

***Other information:*** This technology is currently implemented at Langley AFB. For recommended plantings refer to Section 3.1.

***Cost Benefit Analysis of initial construction:*** Construction and maintenance costs are minimal. Helps to reduce maintenance costs of downstream practices by removing some sediment from runoff. Less expensive to install and maintain than traditional curb and gutters. The need for soil amendment should be assessed in the development of the pre-development hydrology model.

***LEED Certification Points:***

No certification points available.

*Other Resources:*

Virginia DCR. 1999. *Virginia Stormwater Management Handbook*.  
[http://www.dcr.virginia.gov/soil\\_and\\_water/documents/Chapter\\_3-14.pdf](http://www.dcr.virginia.gov/soil_and_water/documents/Chapter_3-14.pdf)

LakeSuperiorStreams. 2009. *LakeSuperiorStreams: Community Partnerships For Understanding Water Quality and Stormwater Impacts at the Head of the Great Lakes*.  
<http://www.duluthstreams.org/stormwater/toolkit/filterstrips.html>

*Recommendation:* Highly recommended for future design and planning at Langley AFB as a low cost alternative to traditional curb and gutter systems.



## PERMEABLE PAVERS



**SOURCE:** Westwood Contractors, Inc.

***Description:*** Alternative to traditional hardscaping pavers where water is allowed to filter through the surface to the underlying soils. Options include grass pavers, where plastic or concrete grid system is filled with aggregate (vegetation may be used to fill voids), porous concrete pavers, or interlocking concrete pavers.

***Application:*** Commonly used in parking lots and other low-traffic areas to replace traditional pavers, allowing stormwater to infiltrate directly into the soil, instead of running off the pavement.

***Advantage:*** Provides groundwater recharge and reduces pollutants in stormwater runoff. Reduces dust. Attractive alternative to traditional sidewalk materials.

***Disadvantage:*** Practice is not suitable for stormwater “hot spots” due to the potential to contaminate groundwater. Hot spots are defined as areas where higher concentrations of pollutants are more likely to occur.

***Maintenance requirements:*** No special maintenance is required. Regular mowing is conducted in line with routine mowing activities.

***Other information:*** Recommended the grid of the pavers be filled with soil and grass to improve aesthetics. Refer to section 3.1 for a recommended grass seed mix. The new dormitory area at Langley AFB uses permeable turf stone pavers alongside the brick sidewalks to improve water drainage from the sidewalk area.

***Cost Benefit Analysis of initial construction:*** Installation costs are more expensive than traditional pavement; however, some of the cost is offset through a reduction in traditional stormwater management practices.

*LEED Certification Points:*

## Sustainable Sites Credits:

- Credit 6.2: Stormwater Design: Quality Control = 1 point

*Other Resources:*

Fairfax County. 2005. *LID BMP Fact Sheet, Permeable/Porous Pavement*. [http://www.lowimpactdevelopment.org/ffxcty/3-2\\_permeablepavement\\_draft.pdf](http://www.lowimpactdevelopment.org/ffxcty/3-2_permeablepavement_draft.pdf)

Interlocking Concrete Paving Institute. [www.icpi.org](http://www.icpi.org)

Low Impact Design Center, Inc. 1999. *Urban Design Tools*.  
[http://www.lid-stormwater.net/permpavers\\_benefits.htm](http://www.lid-stormwater.net/permpavers_benefits.htm)

Westwood Contractors, Inc. 2010. Hampton VA. POC: Brent Chubb,  
(757) 722-0050. [www.westconpavers-va.com](http://www.westconpavers-va.com)

**Recommendation:** Permeable pavers are a recommended technology for implementation at Langley AFB because the use of the pavers as sidewalks does not require any additional maintenance above routine mowing already conducted.



Permeable pavers in place at Langley,  
SOURCE: Westwood Contractors, Inc.

## SOIL AMENDMENTS



SOURCE: [www.epa.gov](http://www.epa.gov)

*Description:* Any material that is thoroughly mixed in with a soil to improve its physical properties, such as water retention, permeability, water infiltration, drainage, aeration and structure. Soil amendments provide water quality treatment by increasing the filtration capacity of the soil.

*Application:* Restores or improves the physical and therefore hydrological characteristics of a soil, so that that soil can then best be utilized for stormwater management purposes. Compared to compacted, non-amended soils, amended soils provide greater infiltration and subsurface storage and thereby help to reduce a site's overall runoff volume, helping to maintain the pre-development peak discharge rate and timing.

*Advantage:* Allows use of previously unsuitable soil for stormwater treatment. Implementation is simple and relatively inexpensive.

*Disadvantage:* Amendment type must consider the type of soil currently present on a site to maintain chemical balance suitable for type of plants to be grown onsite. Added cost to other LID technology designs.

*Other information:* The need for soil amendment should be assessed in the development of the pre-development hydrology model for any type of infiltration design (e.g., rain gardens, grassed swales, infiltration trenches, filter strips). The soil mix may be critical to the proper function of the LID technology.

*Cost Benefic Analysis of initial construction:* Cost of soil amendment and mixing into soil is higher than maintaining native soils; however, increased infiltration of site soils results in more effective stormwater management practices.

*LEED Certification Points:*

No certification points available.

*Other Resources:*

Fairfax County. 2005. *LID BMP Fact Sheet, Soil Amendments*.

[http://www.lowimpactdevelopment.org/ffxcty/5-1\\_soilamendments\\_draft.pdf](http://www.lowimpactdevelopment.org/ffxcty/5-1_soilamendments_draft.pdf)

Low Impact Design Center, Inc. 1999. *Urban Design Tools*.

[http://www.lid-stormwater.net/soilamend\\_benefits.htm](http://www.lid-stormwater.net/soilamend_benefits.htm)

*Recommendation:* Soil amendments are recommended on Langley AFB. More detailed information is provided in Section 3.2 of this manual.

## TRASH RACK



**SOURCE:**  
<http://cweb.salisbury.sa.gov.au>

**Description:** Device used to physically filter out large debris and trash from stormwater before being discharged to a downstream water body.

**Application:** Required component of other stormwater management practices. Commonly used at the outlets of detention basins.

**Advantage:** Easy to install and maintain. Low cost.

**Disadvantage:** Trash racks may become clogged if outlet is not properly designed, causing maintenance and aesthetic issues.

**Maintenance requirements:** Trash racks are currently implemented at Langley AFB and are maintained by Pavements and Grounds.

**Other Information:** Design element to be considered when designing other stormwater drop inlets.

**Cost Benefit Analysis of initial construction:** Installation and maintenance costs are relatively low.

**LEED Certification Points:**

No certification points available.

**Recommendation:** Trash Racks are recommended at Langley AFB in future design and planning projects.

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## VEGETATED BUFFER



Wetland buffer planted at stormwater outfalls at Langley AFB

*Description:* Strips of vegetation (either natural or planted) around sensitive areas such as water bodies, wetlands, woodlands, or highly erodible soils.

*Application:* Provides protection for sensitive areas, as well as some reduction in stormwater impacts by trapping sediment, providing some infiltration, and slowing

and spreading stormwater flows over a wide area.

*Advantage:* Mimics natural hydrology. Slows and filters runoff. Stabilizes shore line. Aesthetically pleasing and can be designed with public use in mind.

*Disadvantage:* Implementation of vegetated buffers may be limited by BASH. BASH should be considered depending on location of project.

*Maintenance requirements:* Minimal maintenance is required and most likely will become self-sustaining. Inspections should be conducted annually or after large storm events for evidence of sediment deposition, erosion, or other feature changes.

*Other information:* A list of recommended plants for a vegetated buffer can be found in Section 3.1. Additionally, refer to the results of the wetland buffer planted on Langley AFB for design and planning considerations.

*Cost Benefic Analysis of initial construction:* Minimal maintenance costs. Initial construction costs are moderate, unless vegetated buffer is natural (i.e. existing buffer being preserved during site construction activities). The need for soil amendment should be assessed in the development of the pre-development hydrology model as discussed in section 3.2.

*LEED Certification Points:*

## Sustainable Sites Credits:

- Credit 5.1: Site Development: Protect or Restore Habitat = 1 point
- Credit 6.2: Stormwater Design: Quality Control = 1 point

*Other Resources:*

Fairfax County. 2005. *LID BMP Fact Sheet, Environmentally Sensitive Landscaping*. [http://www.lowimpactdevelopment.org/ffxcty/6-1\\_landscaping\\_draft.pdf](http://www.lowimpactdevelopment.org/ffxcty/6-1_landscaping_draft.pdf)

LakeSuperiorStreams. 2009. *LakeSuperiorStreams: Community Partnerships For Understanding Water Quality and Stormwater Impacts at the Head of the Great Lakes*.  
<http://www.duluthstreams.org/stormwater/media/RWMWD-BuffersBrochure.pdf>

*Recommendation:* Vegetated buffers are recommended to be implemented in design and planning for future projects at Langley AFB.



## RAINWATER RETENTION: RAIN BARRELS and CISTERNS



**SOURCE:**  
[www.lowimpactdevelopment.org](http://www.lowimpactdevelopment.org)

**Description:** Storage vessels used to capture and store rooftop runoff for reuse in a number of applications, such as irrigation, wash water, and other non-potable uses.

**Application:** Used to provide some detention and storage of rooftop runoff for later use in irrigation and other non-potable water applications.

**Advantage:** Rain barrels are low in cost and easily maintainable. Community organizations can use rain barrel construction workshops as an outreach activity. Rain barrels may

be retrofitted to existing structures to capture rooftop runoff on a smaller scale for irrigation purposes. Cisterns can hold thousands of gallons which can be used as a non-potable source for irrigation or non-potable applications such as toilet flushing or for wash down facilities.

**Disadvantage:** Rain barrels have relatively small storage volume (about 60 gallons). Design of rain barrels and cisterns must consider roof dimensions to quantify volume needed. Overflow device needed for excess runoff volume.

**Maintenance requirements:** Periodic container inspection to ensure water is draining properly to the unit and no debris or pests have collected.

**Other information:** Rain barrels provide an excellent opportunity for community/public education in stormwater management and practices. Rain barrels are able to be retrofitted into existing designs and would be beneficial in low-visibility areas, such as homes and child care centers and not considered part of a design element in base planning. Cisterns should be considered in the design and planning of

new facilities. Screen walls or other methods to enhance the appearance of these items may be considered depending on the proposed location.

*Cost Benefit Analysis of initial construction:* Installation and maintenance costs are low, and captured stormwater used for irrigation and/or non-potable applications may offset some purchased water costs.

*LEED Certification Points:*

Sustainable Sites Credit:

- Credit 6.1: Stormwater Design: Quantity Control = 1 point

*Other Resources:*

LakeSuperiorStreams. 2009. *LakeSuperiorStreams: Community Partnerships For Understanding Water Quality and Stormwater Impacts at the Head of the Great Lakes.*

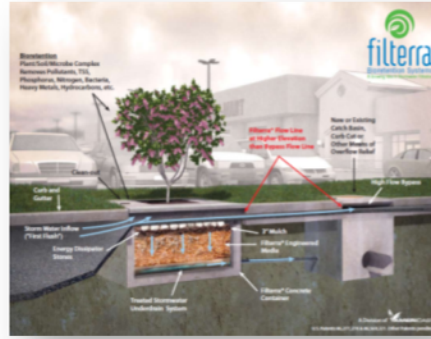
<http://www.duluthstreams.org/stormwater/toolkit/rainbarrels.html>

Low Impact Design Center, Inc. 1999. *Urban Design Tools.*

[http://www.lid-stormwater.net/raincist\\_home.htm](http://www.lid-stormwater.net/raincist_home.htm)

*Recommendation:* Rain barrels are advisable on a small scale community service program or as a retro-fit project at Langley AFB. Cisterns can be implemented in design and planning where rain water can serve as irrigation or other non-potable use resource.

## TREE BOX FILTER



SOURCE: [www.filterra.com](http://www.filterra.com)

**Description:** Tree box filters are mini-bioretention areas installed as stormwater management technologies that can be very effective at controlling runoff, especially when distributed throughout the site. Consists of a container filled with a soil mixture, a mulch layer, under-drain system and a shrub or tree.

**Application:** Commonly used in urban areas to treat a portion of the runoff from impervious sidewalks and roads. Runoff is directed to the tree box, then passes through the soil and root system which acts as a filter before entering into a infiltration device or other stormwater management device. Generally are installed in conjunction with traditional stormwater inlets in the event of high flow storm events.

**Advantage:** Easy to retrofit into existing sites and pretreatment is usually not necessary. Can be installed in “hot spots” (areas where higher concentrations of pollutants are more likely to occur) as well as areas with a high water table. Added value of aesthetics to urban landscaping.

**Disadvantage:** Filter media may become clogged if surrounding drainage area is not stabilized. A maintenance contract may be required.

**Maintenance requirements:** Maintenance recommendations include annual inspection and removal trash and debris. Mulch may require replenishment up to two times per year. Depending on product, this technology may require a maintenance contract to perform mulch replenishment and cleanout. Some products are sold with a maintenance agreement built into the base price.

**Other information:** Tree selection should be made based on space, overhead restrictions, proximity to sidewalks and utility lines, amount of

shade/sun, etc. Choose smaller tree species such as *Amelanchier* sp., *Cercis canadensis*, *Chionanthus* sp., *Cornus* sp., *Crataegus* species or small *Magnolia* species. *Quercus palustris* and *Quercus phellos* are also popular choices however they are larger species.

*Cost Benefit Analysis of initial construction:* More expensive to install than traditional catch basin inlets, but costs can be incorporated into landscaping costs for new sites. Stormwater infrastructure costs may be reduced if tree box filter is installed as infiltration system.

#### *LEED Certification Points:*

Sustainable Sites Credits:

- Credit 6.2: Stormwater Design: Quality Control = 1 point
- Credit 7.1: Heat Island Effect<sup>1</sup>: Non-Roof = 1 point

Water Efficiency Credits:

- Credit 1.2: Water Efficient Landscaping (No Potable Use) = 1 point

#### *Other Resources:*

Fairfax County. 2005. *LID BMP Fact Sheet, Tree Box Filters*.

[http://www.lowimpactdevelopment.org/ffxcty/1-6\\_treebox\\_draft.pdf](http://www.lowimpactdevelopment.org/ffxcty/1-6_treebox_draft.pdf)

<http://www.filterra.com/>

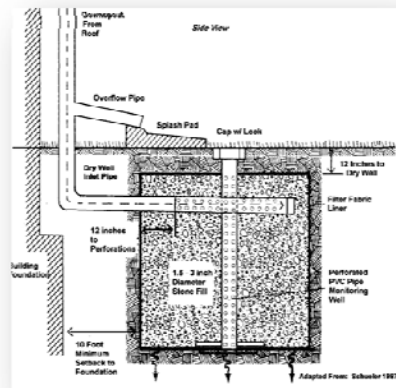
Low Impact Design Center, Inc. 1999. *Urban Design Tools*.

[http://www.lid-stormwater.net/treeboxfilter\\_maintain.htm](http://www.lid-stormwater.net/treeboxfilter_maintain.htm)

*Recommendation:* Tree box filters are recommended to be implemented in design and planning for future projects at Langley AFB; however, the maintenance requirements should be confirmed with operations to see if a maintenance contract is required.

<sup>1</sup> This credit may only be achieved if tree box filters can be installed to provide shade for 50% of the site's hardscape.

## DRY WELLS



**Source:** Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs (Scheuler, T.R. 1987)

**Description:** A small excavated pit backfilled with aggregate such as pea gravel or stone that is used to infiltrate runoff from rooftops and/or surrounding drainage area.

**Application:** Commonly used to control runoff from rooftops by allowing infiltration into surrounding soils. May also be used as a modified catch basin to capture and infiltrate runoff from direct surface runoff.

**Advantage:** Reduces stormwater runoff and peak discharge rate. Downstream management practices may be smaller. Local hydrology benefits from increased base flow.

**Disadvantage:** Pretreatment is necessary (except for rooftop drains) to prevent premature failure that results from clogging with fine sediment, and to prevent potential groundwater contamination due to nutrients, salts, and hydrocarbons. Not suitable for low permeability soils or fill areas.

**Maintenance requirements:** To maintain these structures, accumulated debris and weeds must be removed periodically from the surface. Dry wells eventually clog over time with sediment and the stone will need to be removed and washed to clean out the accumulated sediment and debris.

**Other information:** Implementing dry wells is dependent on site location as Langley AFB sits very close to the groundwater table and the selected site may not accommodate a vertical feature. Location and depth to groundwater are to be considered in design.

*Cost Benefit Analysis of initial construction:* Moderate cost for construction; however, dry wells allow conveyance structures such as swales and pipes to be downsized, saving costs. Periodic maintenance may not be covered under operations and maintenance costs.

*LEED Certification Points:*

Sustainable Sites Credit:

- Credit 6.2: Stormwater Design: Quality Control = 1 point

*Other Resources:*

Fairfax County. 2005. LID BMP Fact Sheet, Dry Wells.

[http://www.lowimpactdevelopment.org/ffxcty/2-2\\_drywells\\_draft.pdf](http://www.lowimpactdevelopment.org/ffxcty/2-2_drywells_draft.pdf)

*Recommendation:* Not recommended for use at Langley AFB (maintenance and limitations on implementation).

## INFILTRATION TRENCH



SOURCE: [www.lakecountyil.gov](http://www.lakecountyil.gov)

*Description:* An infiltration trench is an excavated trench, three to 12 feet deep, backfilled with a stone aggregate, and lined with filter fabric which filters pollutants out of runoff as it infiltrates the surrounding soil.

*Application:* Used to capture and treat small quantities of stormwater runoff in areas with limited land availability. The captured runoff infiltrates the surrounding soils and increases groundwater recharge and baseflow in nearby streams.

*Advantage:* Mimics pre-development hydrology allowing for infiltration. Provides efficient removal of suspended solids, particulate pollutants, coliform bacteria, organics and some soluble forms of metals and nutrients from stormwater runoff.

*Disadvantage:* Not a suitable application for Langley AFB due to low permeability soils and high water table. Drainage area must be developed and stabilized with vegetation to prevent clogging from runoff with high sediment loads.

*Maintenance requirements:* Sedimentation and weed prevention are two maintenance issues associated with infiltration trenches. Inspections are recommended after large storm events to assess any accumulated debris that requires removal.

*Cost Benefit Analysis of initial construction:* Installation and maintenance costs are higher than traditional grassed swales; however, land area cost savings offset some of these costs.

*LEED Certification Points:*

## Sustainable Sites Credits:

- Credit 6.2: Stormwater Design: Quality Control = 1 point

*Other Resources:*

Virginia DCR. *Virginia Stormwater Management Handbook*. 1999.  
[http://www.dcr.virginia.gov/soil\\_and\\_water/documents/Chapter\\_3-10.pdf](http://www.dcr.virginia.gov/soil_and_water/documents/Chapter_3-10.pdf)

California Stormwater Quality Association. 2003. *California Stormwater BMP Handbook*.  
<http://www.cabmphandbooks.com/Documents/Industrial/TC-10.pdf>

Fairfax County. 2005. LID BMP Fact Sheet, Infiltration Trench.  
[http://www.lowimpactdevelopment.org/ffxcty/3-1\\_infiltrationtrench\\_draft.pdf](http://www.lowimpactdevelopment.org/ffxcty/3-1_infiltrationtrench_draft.pdf)

*Recommendation:* Not recommended for implementation at Langley AFB due to sedimentation and maintenance requirements. Additionally, depending on location of the proposed site, proper infiltration may be an issue.



## INLET PROTECTION DEVICES



**SOURCE:** [www.suntreetech.com](http://www.suntreetech.com)

**Description:** Manufactured devices used in catch basins to treat stormwater runoff with a settling or separation unit to remove sediments, oil and grease, trash, and other pollutants

**Application:** May be used as pre-treatment for other stormwater management devices. Inlet protection devices

are commonly used in potential stormwater “hot spots” (areas where higher concentrations of pollutants are more likely to occur).

**Advantage:** Treats runoff from stormwater “hot spots”. Able to be retrofitted into existing catch basins and curb inlets. Extends the life of downstream stormwater management practices.

**Disadvantage:** Expensive to install and maintain.

**Maintenance requirements:** Maintenance contract is recommended with the installation of these devices. Frequent inspections are recommended. Sediment removal must be performed as needed with a sump-vac or vacuum truck.

**Other Information:** The depth to groundwater of the proposed site must be considered as these devices are installed to a depth of four feet below ground surface.

Langley AFB has inlet protection devices installed in some areas; however, these inlet protection devices have not been properly maintained over their lifespan. Stockpiled sediments could potentially be a source of stormwater pollutants. At the time of the production of this manual, the devices are being cleaned out.

**Cost Benefit Analysis of initial construction:** Construction and maintenance costs are high.

*LEED Certification Points:*

## Sustainable Sites Credit:

- Credit 6.2: Stormwater Design: Quality Control = 1 point

*Other Resources:*

California Stormwater Quality Association. 2003. Drain Insert MP-52.  
<http://www.cabmphandbooks.com/Documents/Industrial/MP-52.pdf>

*Recommendation:* These devices are not recommended at Langley AFB because they require a maintenance contract and the depth to groundwater may be a limiting factor.

## PERMEABLE PAVEMENT



SOURCE: [www.epa.gov](http://www.epa.gov)

stormwater to infiltrate directly into the soil, instead of running off the pavement.

**Advantage:** Provides groundwater recharge and reduces pollutants in stormwater runoff. May slow surface sheet flow.

**Disadvantage:** Practice is not suitable for stormwater “hotspots” (areas where higher concentrations of pollutants are more likely to occur) due to the potential to contaminate groundwater. Extensive maintenance (including vacuum sweeping) required to reduce clogging of pavement.

**Maintenance requirements:** Maintenance recommendations include quarterly vacuuming and/or power washing. Ensure that patches and repairs are conducted using permeable pavement fill and not standard top mix.

**Other information:** A case study for permeable pavements is recommended for Langley AFB.

**Cost Benefit Analysis of initial construction:** Installation and maintenance costs are significantly more expensive than traditional pavement; however, some of the cost is offset through a reduction in traditional stormwater management practices such as retention basins and stormwater drains. The lifespan of permeable pavement is 15 to 20

**Description:** Permeable pavement surface with an underlying stone reservoir that temporarily stores surface runoff before infiltrating into the subsoil.

**Application:** Commonly used in parking lots and other low-traffic areas to replace traditional pavement, allowing

years with correct maintenance; however, this lifespan is significantly reduced if not properly maintained.

#### *LEED Certification Points:*

Sustainable Sites Credits:

- Credit 6.2: Stormwater Design: Quality Control = 1 point

#### *Other Resources:*

Virginia DCR. 1999. *Virginia Stormwater Management Handbook*.  
[http://www.dcr.virginia.gov/soil\\_and\\_water/documents/Chapter\\_3-10.pdf](http://www.dcr.virginia.gov/soil_and_water/documents/Chapter_3-10.pdf)

Fairfax County. 2005. *LID BMP Fact Sheet, Permeable/Porous Pavement*. [http://www.lowimpactdevelopment.org/ffxcty/3-2\\_permeablepavement\\_draft.pdf](http://www.lowimpactdevelopment.org/ffxcty/3-2_permeablepavement_draft.pdf)

Low Impact Design Center, Inc. 1999. *Urban Design Tools*.  
[http://www.lid-stormwater.net/permpavers\\_benefits.htm](http://www.lid-stormwater.net/permpavers_benefits.htm)

LakeSuperiorStreams. 2009. *LakeSuperiorStreams: Community Partnerships For Understanding Water Quality and Stormwater Impacts at the Head of the Great Lakes*.  
<http://www.duluthstreams.org/stormwater/toolkit/paving.html>

California Stormwater Quality Association. 2003. *California Stormwater BMP Handbook*.  
<http://www.cabmphandbooks.com/Documents/Development/SD-20.pdf>

*Recommendation:* Permeable pavement is not recommended at Langley AFB at this time because of maintenance concerns voiced during the roundtable session. The use of permeable pavement may be revisited if a case study is performed.

## REFORESTATION



Source: [www.ces.ncsu.edu](http://www.ces.ncsu.edu)

*Description:* Practice of planting of trees in an area that was forested in the recent past. Trees may be placed strategically as a buffer, or in flow paths and depressions to adsorb runoff.

*Application:* Trees reduce runoff volume through evapotranspiration and interception and improve the infiltration capacity of the soil, thereby reducing runoff potential.

*Advantage:* Reduces runoff potential on a site, which reduces the peak discharge.

Minimal maintenance required once plants are established.

*Disadvantage:* Large land area required. Not compliant with BASH.

*Cost Benefit Analysis of initial construction:* Relatively high initial cost compared to grass or other groundcover. Minimal maintenance costs. Loss of land area for other uses.

### *LEED Certification Points:*

Sustainable Sites Credits:

- Credit 1: Site Selection - 1 Point
- Credit 5.1: Protect or Restore Habitat - 1 Point
- Credit 6.1: Stormwater Design: Quantity Control – 1 point

Water Efficiency Credits:

- Credit 1.1: Water Efficient Landscaping – 1 Point

*Other Resources:*

Fairfax County. 2005. *LID BMP Fact Sheet, Reforestation/Afforestation*.  
[http://www.lowimpactdevelopment.org/ffxcty/6-3\\_reforestation\\_draft.pdf](http://www.lowimpactdevelopment.org/ffxcty/6-3_reforestation_draft.pdf)

*Recommendation:* Reforestation is a BASH issue and therefore will not be implemented at Langley AFB.

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Section 5: Langley AFB Site Design Case Study

In order to demonstrate how LID technologies can be implemented at Langley AFB, a proposed design was created for the Veterinary Clinic proposed for construction in the North Base Support Area. The clinic and associated parking area in a traditional design would create an impervious footprint of 0.17 acres. A challenge with this site is the pre-development condition of the site is forested; therefore, mimicking the natural hydrology could pose challenging.

Figure 5-1 depicts the footprint of the proposed veterinarian clinic, a sidewalk and a parking lot adjacent to the road. Note the lot is currently wooded and prevailing surface water flow is to the northeast. The data used to model the predevelopment hydrology using TR-55 are provided in Table 5-1.



Figure 5-1: Aerial of proposed veterinary clinic at Langley AFB



Table 5-1. Pre-Development hydrograph

Description	Comment
Dimensionless Unit Hydrograph	Provided by TR-55
Storm Data Source	Provided by TR-55
Rainfall Distribution Identifier	Provided by TR-55
Sub-Area Name	Vet Clinic
Sub-Area Description	Pre-Development
Sub-Area Discharge Type (reach or outlet)	Outlet
Area	1.32 acres
Weighted Curve Number (CN)*	70
Time of Concentration (T <sub>c</sub> )	0.483 hours
Peak Flow	2.18 cubic feet per second (cfs)
Time to Peak Flow	12.20 hours

\* Weighted CN is provided in the table found in Appendix B.

Using the information above for a 5-year storm based on James City County, Virginia rainfall data results in a peak discharge of 2.18 cfs at 12.20 hours. The output hydrograph and the input data screen are depicted in Figure 5-2.

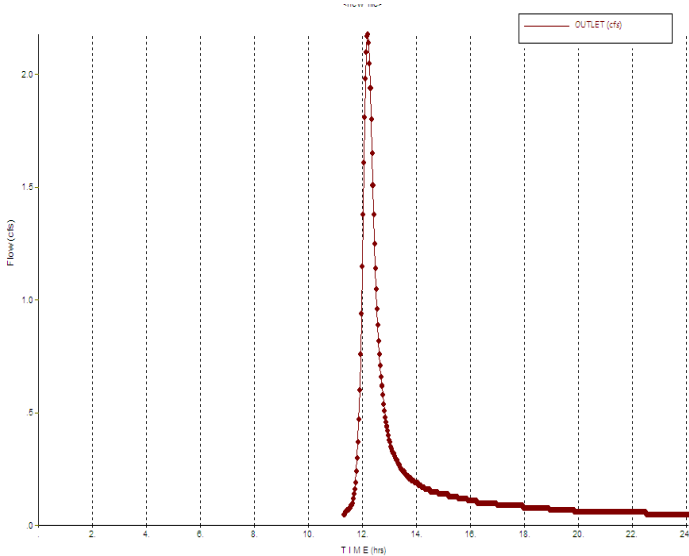


Figure 5-2: Pre-development hydrograph produced from TR-55. (X axis is time in hours, and the y axis is peak flow in cubic feet per second).

A post-development scenario using traditional design includes a 12 space parking lot (2000 square feet = 0.05 acres), a 4600 ft<sup>2</sup> building (0.11 acres) and a sidewalk. This decreases the wooded area to 1.15 acres and adds an impervious area of 0.17 acres. These changes increase the calculated curve number to 74 and the peak flow to 3.18 cfs and decrease the time of concentration to 0.335 hours. The data used to model the post-development hydrology are provided in Table 5-2. Note specifically the increased CN. The output hydrograph from the post-development data is represented as the blue line in Figure 5-3. The pre-development hydrograph is shown in red. Remember, the goal of LID implementation is to mimic the pre-development hydrology

Remember, the goal of LID implementation is to mimic the pre-development hydrology

Table 5-2. Post-Development Data

Description	Comment
Dimensionless Unit Hydrograph	Provided by TR-55
Storm Data Source	Provided by TR-55
Rainfall Distribution Identifier	Provided by TR-55
Sub-Area Name	Vet Clinic Building
Sub-Area Description	Post-Development
Sub-Area Discharge Type	Outlet
Area	1.32 acres
Weighted CN	74
T <sub>c</sub>	0.335 hours
Peak Flow	3.18 cfs
Time to Peak Flow	12.09 hours

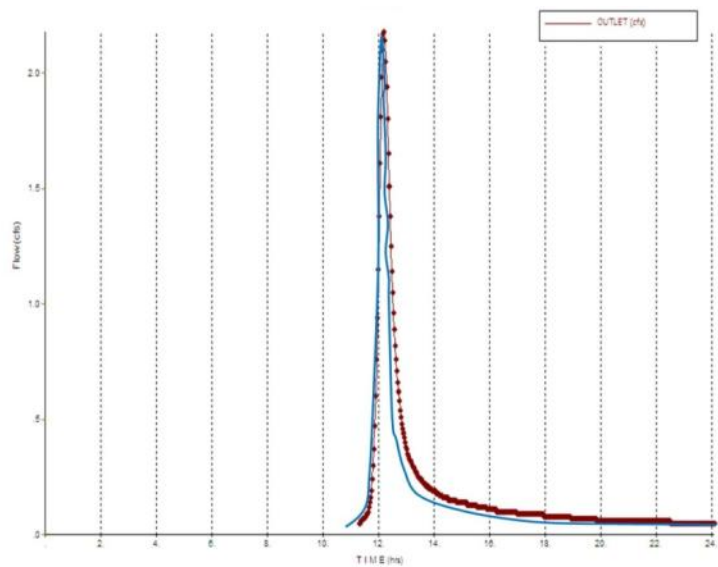


Figure 5-3: Post-development hydrograph produced from TR-55 with no LID technologies implemented. Note the pre-development curve is in red and the post-development curve is in blue.

LID techniques are used to increase the post-development  $T_c$  and decrease the CN. There are an almost infinite number of combinations of LID techniques that will achieve the LID objectives. As discussed in the technology pages installation specific constraints impact the design choices. Cost, maintenance, compliance with other AF MILCON standards are all to be taken into consideration.

*LID techniques are used to increase the post-development time of concentration and decrease the curve number.*

LID technologies implemented for this case study are permeable pavers for the small parking lot, sidewalk, and a perimeter walk around the clinic. A grassed swale was added at the northeast side of the site to capture roof runoff and improve infiltration across the site. Assuming a four foot sidewalk width, the area addressed with LID technologies is

0.18 acres. The data used to model the post-development hydrology with LID technologies implemented are provided in Table 5-3. The resulting hydrograph is presented in Figure 5-4.

Table 5-3. Post-development data with LID implemented

Description	Comment
Dimensionless Unit Hydrograph	Provided by TR-55
Storm Data Source	Provided by TR-55
Rainfall Distribution Identifier	Provided by TR-55
Sub-Area Name	Vet Clinic Building
Sub-Area Description	LID Components in Place
Sub-Area Discharge Type (reach or outlet)	Outlet
Area	1.32 acres
Weighted CN	71
T <sub>c</sub>	0.486 hours
Peak Flow	2.27 cfs
Time to Peak Flow	12.20

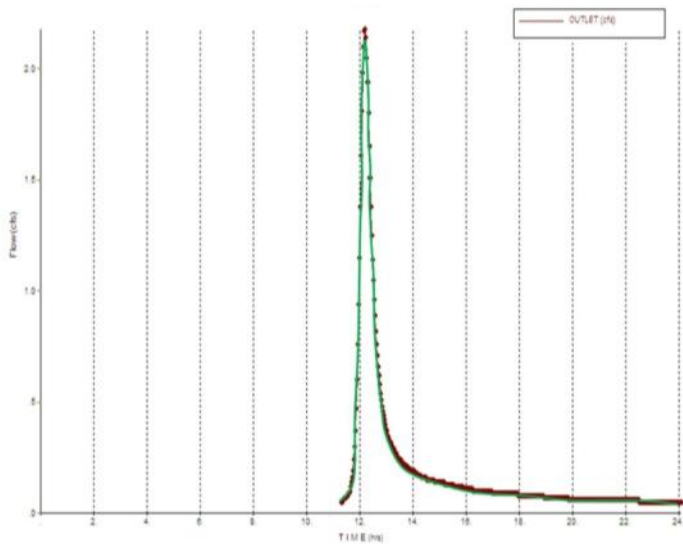


Figure 5-4: Post-development hydrograph produced from TR-55 with LID implemented. The green line represents the post-development hydrograph with LID technologies implemented. The red is the pre-development curve.

Using the LID techniques described above reduced the curve number to almost pre-development conditions and also significantly decreased the peak flow. You'll notice the post-development hydrograph mimics the pre-development hydrograph in Figure 5-4. Additionally, the techniques actually increased the time of concentration slightly above the pre-development  $T_c$ . This example shows the effectiveness of LID techniques to minimize post-development stormwater impacts. This site has some unique challenges due to its small size. However, the ability to retain most of the natural woods and minimize additional parking reduced the overall challenge presented by this small site.

## Appendix A

### Acronyms and References

### Acronyms

AF	Air Force
AFB	Air Force Base
BASH	Bird Aircraft Strike Hazard
BMP	Best Management Practice
CBPA	Chesapeake Bay Preservation Act
cfs	Cubic feet per second
CN	Curve Number
DCR	Department of Conservation and Recreation
DoD	Department of Defense
EISA	Energy Independence Security Act
E.O.	Executive Order
EPA	Environmental Protection Agency
Ft	Feet
Ft <sup>2</sup>	Square feet
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
MOU	Memorandum of Understanding
NRCS	Natural Resources Conservation Services
Pg	Page
pH	Potential for hydrogen
SDD	Sustainable Design and Development
SWMM	Stormwater Management Model
SWPPP	Stormwater Pollution Prevention Plan
T <sub>c</sub>	Time of concentration
TMDL	Total Maximum Daily Load
TR-55	WinTR-55
UFC	Unified Federal Code

## References

Department of Defense. 25 October 2004. *Unified Facilities Criteria (UF), Low Impact Development*. UFC 3-210-10.

Department of the Air Force. 31 July 2007. *Memorandum: Air Force Sustainable Design and Development (SDD) Policy*.

Energy Independence Security Act of 2007.

Executive Order (E.O.) 13423. January 2007. *Strengthening Federal Environmental, Energy, and Transportation Management*.

E.O. 13514. October 2009. *Federal Leadership in Environmental, Energy, and Economic Performance*

Memorandum of Understanding (MOU). May 2006. *Federal Leadership in High Performance and Sustainable Buildings*.

Natural Resources Conservation Service (NRCS). January 2009. *Small Watershed Hydrology WinTR-55 User Guide*.

Prince George's County, Maryland Department of Environmental Resources. June 1999. *Low-Impact Development Design Strategies, An integrated Design Approach*.

Virginia Department of Conservation and Recreation. 2001. *Virginia Stormwater Management Regulations*. 4 VAC 3-20.

Virginia Department of Conservation and Recreation. 2008. *Chesapeake Bay Preservation Area Designation and Management Regulations*. 9 VAC 10-20-10.

Virginia's Low Impact Development Assessment Task Force. February 2008. *Low Impact Development Technical Bulletin Final Draft*.

US EPA. December 2007. *Reducing Stormwater costs through Low Impact Development (LID) Strategies and Practices*. EPA 841-F-07-006.



----- July 2009. *Stormwater Management Model User's Manual*,  
Version 5.0. EPA 600-R-05-040.

Appendix B  
Curve Number Table

Input curve numbers are read directly from the table by determining

- a) the most representative land use description; and
- b) the hydrologic soil group.

Both (a) and (b) require some level of judgment from the modeler. The land use description is a little more subjective than the hydrologic soil group. However, the land use description should be taken as literally as possible and dependence on judgment of the hydrologic soil group can be minimized if representative soil borings from the area have been taken. In the model example the curve number was derived using woods in good condition with a hydrologic soil group C.

The model will calculate custom curve numbers based on user input if the land use description in the table does not represent the land use description of the area being modeled.

Land Use Description	Description and Curve Numbers from TR-55					
	Cover Description		Curve Number for Hydrologic Soil Group			
	Cover Type and Hydrologic Condition	% Impervious Areas	A	B	C	D
<b>Agricultural</b>	Row Crops - Straight Rows + Crop Residue Cover- Good Condition		64	75	82	85
<b>Commercial</b>	Urban Districts: Commercial and Business	85	89	92	94	95
<b>Forest</b>	Woods - Good Condition		30	55	70	77
<b>Grass/ Pasture</b>	Pasture, Grassland, or Range - Good Condition		39	61	74	80
<b>High Density Residential</b>	Residential districts by average lot size: 1/8 acre or less	65	77	85	90	92
<b>Industrial</b>	Urban district: Industrial	72	81	88	91	93
<b>Low Density Residential</b>	Residential districts by average lot size: 1/2 acre lot	25	54	70	80	85

Land Use Description	Description and Curve Numbers from TR-55					
	Cover Description		Curve Number for Hydrologic Soil Group			
	Cover Type and Hydrologic Condition	% Impervious Areas	A	B	C	D
<b>Open Spaces</b>	Open Space (lawns, parks, golf courses, cemeteries, etc.) Fair Condition (grass cover 50% to 70%)		49	69	79	84
<b>Parking and Paved Spaces</b>	Impervious areas: Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	100	98	98	98	98
<b>Residential 1/8 acre</b>	Residential districts by average lot size: 1/8 acre or less	65	77	85	90	92
<b>Residential 1/4 acre</b>	Residential districts by average lot size: 1/4 acre	38	61	75	83	87
<b>Residential 1/3 acre</b>	Residential districts by average lot size: 1/3 acre	30	57	72	81	86
<b>Residential 1/2 acre</b>	Residential districts by average lot size: 1/2 acre	25	54	70	80	85
<b>Residential 1 acre</b>	Residential districts by average lot size: 1 acre	20	51	68	79	84

Land Use Description	Description and Curve Numbers from TR-55						
	Cover Description				Curve Number for Hydrologic Soil Group		
	Cover Type and Hydrologic Condition	% Impervious Areas	A	B	C	D	
Residential 2 acres	Residential districts by average lot size: 2 acre	12	46	65	77	82	

Source: NRCS, January 2009.

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Appendix C  
LID Cost Table



**Appendix C:** LID Cost table is presented in Table C-1.

The low, high, and median costs are generated from the estimate sources listed in the cost source column. Remedial Action Cost and Engineering Requirements (RACER) version 10.3 software was used to develop a base level planning cost in the column RACER below.

RACER is a parametric cost estimating tool used to develop engineering estimates for the DoD environmental programs and serves as a realistic planning tool for out year environmental cost requirements. Some technologies listed in Table C-1 that are structural designs, such as permeable pavement or trash racks, are not a technology available within the RACER program and a cost could not be generated. Please see Table C-2 for the input parameters used to generate the RACER estimates.

It is recommended the cost table is periodically reviewed and updated with actual on-site costs.

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX OO

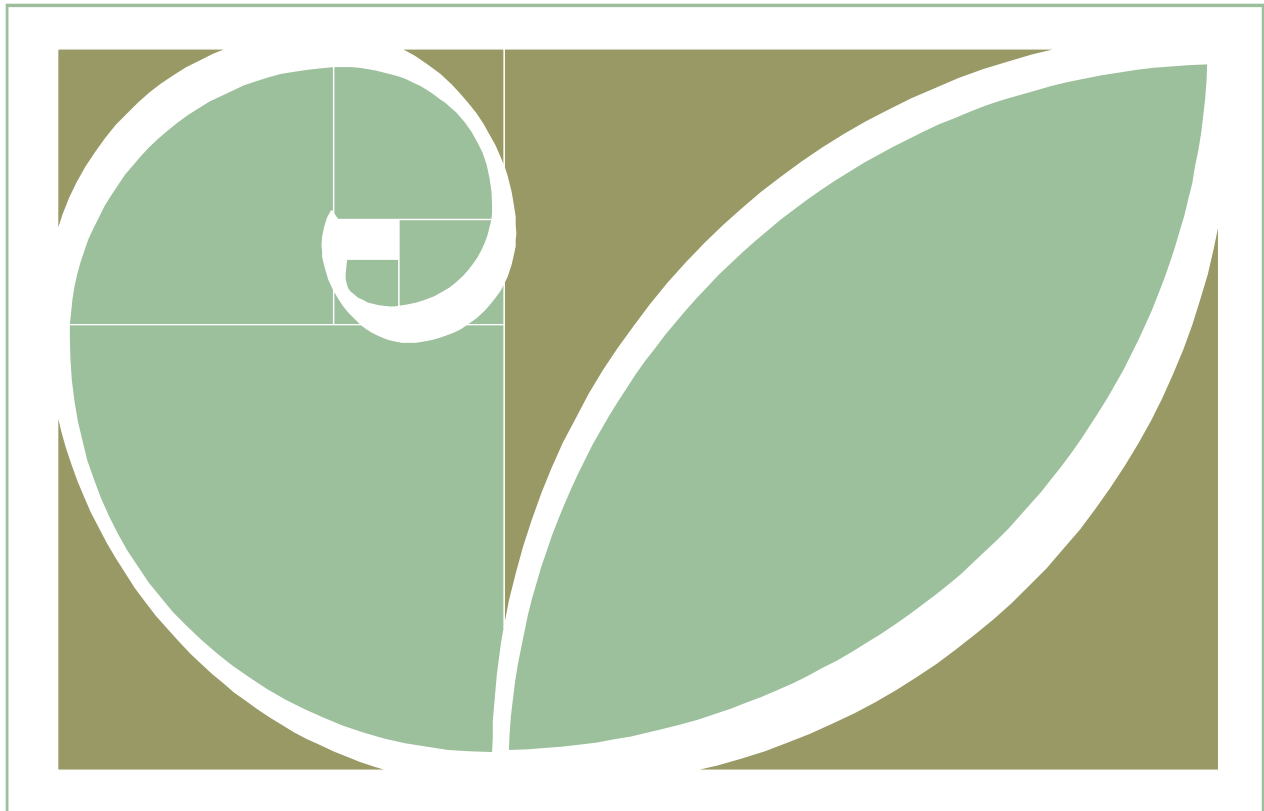
### ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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## **ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics**



**Supported by the USGBC LEED v2009 Rating System**

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Sept 2009

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**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics****Disclaimer**

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## ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics

### Introduction

ACC commits to re-aligning current planning, design and construction practices so that implementing Sustainable Design & High Performance Green Building (SD&HPGB) objectives become primary considerations along with Building Site, Context, Program & Scale, and Hierarchical Importance. A holistic design approach will consider, balance, and weigh simultaneously the myriad factors stemming from each primary design driver and develop a unified design solution appropriate to the building site, sensitive to the built context, reflective of the program needs and scale, responsive to the hierarchical importance, and fully implementing SD&HPGB objectives.

This publication serves to establish Command-wide SD&HPGB guidance. Updated guidance for companion primary drivers will be addressed in publication of an Air Combat Command Instruction (ACCI) and Design Handbook (both forthcoming) however interim Command-wide changes in architectural design requirements are being published simultaneously with this document.

This publication and the accompanying ACC Sustainable Design & High Performance Green Building Scorecard (ACC Scorecard) assembles, distills and consolidates Executive Orders (EO), Public Laws and Federal Agency rulemaking on sustainable design & high performance green building requirements into a single, unified and definitive resource. Together, the publications will enable planning, design and construction teams to understand SD&HPGB requirements and allow the AF/ACC to track implementation of objectives at the project level. Air Combat Command is also working directly with the USGBC to implement tracking of identified objectives directly into the LEED on-line system (currently in development).

This publication has been written assuming (1) the project scope is new vertical construction or major renovation and includes climate control systems and (2) the project is at an early development stage. However, statutory requirements and implementation strategies identified are applicable to vertical construction/major renovation projects in later development stages; design/construction teams must evaluate impact of implementing and obtain ACC/A7P guidance when conflicts arise. Additionally, SD&HPGB objectives should be implemented insofar as applicable and to the maximum extent practicable in both Sustainment, Restoration and Modernization (SRM) projects and Horizontal, Utility, and Industrial (HUI) projects. Reporting requirements identified in this publication are **not** applicable to these project types at this time.

In all projects, it is incumbent the Installation, the Command and the design-construction agent work together to coordinate acquisition strategies, A-E Scope of Work descriptions, RFP solicitations, D-B-B and D-B contracts so that SD&HPGB statutory minimum requirements and objectives identified are carried forward and are fully integrated into our completed facilities.

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics****Role of LEED®**

**There is a fundamental difference between meeting statutory minimum requirements and getting LEED® credits/rating.**

The US Green Building Council (USGBC) Leadership in Environmental and Energy Design (LEED®) rating system is used in this publication as an aid in describing technical requirements and as a measurement tool. USGBC LEED® credits referenced herein are to the 2009 version.

It is possible to earn a LEED® rating and still fail to meet critical statutory minimum requirements. This document clarifies the often misunderstood relationships between LEED® credits/rating and federal agency statutory minimum requirements and identifies overlaps, similarities and divergences. The ACC Scorecard tracks and tallies status in meeting statutory minimum requirements and progress towards meeting AF/ACC LEED® certification rating level.



**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics****Air Combat Command SD&HPGB Goal**

**Project planning, design and construction teams must meet baseline objectives (statutory minimum requirements) and implement additional SD&HPGB measures that will in aggregate achieve minimum LEED® Silver certification rating.**

**Air Combat Command SD&HPGB Reporting Procedures**

Planning, design and construction teams must prepare a Project Sustainable Design & High Performance Green Design Analysis (SD&HPGD Analysis) which incorporates the ACC Scorecard. The SD&HPGB Analysis shall address each design objective and discuss how that objective is incorporated into the project; address why other features were not included; address the cost of high performance green features; address synergies between high performance green features; and clearly describe anticipated construction-phase sustainable design & high performance green building design features. Maintain and update the SD&HPGB Analysis at each project phase to reflect objectives currently being met and those anticipated in subsequent phases. An example SD&HPGB Analysis is posted on the ACC Sustainable Installations dashboard.

Planning/Pre-Design Phase: It is crucial that SD&HPGB objectives be fully understood and alternative strategies explored at this stage of development. When drafting the Customer Project Requirements (CPR) / Customer Concept Documents (CCD) documents, prepare three viable, alternative designs. Submit the CPR/CCD including the SD&HPGB Analysis and Energy Modeling Study electronically to ACC/A7PS for coordination and review. Planning/Pre-Design Phase documents are intended to fully support the DD1391 and uncover any project scope issues and validate the project funding levels. Provide accompanying PDF sketches/files of floor plans, building sections, elevations, and site plans which should serve to illustrate the project SD&HPGB intent. Additionally, provide SketchUp files.

Schematic Design Phase: At this stage, a single solution will be identified and design efforts should focus on refining and further developing SD&HPGB implementation strategies. Submit the SD&HPGB Analysis and Energy Modeling Study electronically to ACC/A7PS for coordination and review. Provide accompanying PDF sketches/files of floor plans, building sections, elevations, and site plans which should serve to illustrate the project SD&HPGB intent. Additionally, provide SketchUp files.

Construction Documents (100%) Phase: At this stage, complete documents will have been prepared with SD&HPGB objectives fully developed and in place. Submit the SD&HPGB Analysis and Energy Modeling Study electronically to ACC/A7PS for coordination and review. Provide accompanying PDF files of floor plans, building sections, elevations, and site plans which illustrate the project SD&HPGB measures. Additionally, provide SketchUp files.

## **ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics**

Construction Phase: At this stage, the facility is complete and SD&HPGB design strategies are mostly a reality. There will be some remaining SD&HPGB efforts requiring follow through such as ACC Building Commissioning and ongoing Measurement and Verification. Submit the SD&HPGB Analysis electronically to ACC/A7PS for coordination and review. Provide accompanying PDF files of floor plans, building sections, elevations, and site plans which illustrate the project SD&HPGB measures.

Post Construction Phase: At this stage, the facility is complete and SD&HPGB design strategies in place. Any remaining SD&HPGB efforts from the Construction Phase have been completed. Submit the SD&HPGB Analysis electronically to ACC/A7PS for review and record keeping. Provide accompanying PDF files of floor plans, building sections, elevations, and site plans which illustrate the project SD&HPGB measures.

### **Project Phases and Key Considerations**

Refer to the ACC Scorecard for project phase decision point recommendations for each individual line item. The following discussions are more general in nature.

#### **Requirements and Management Plan (RMP)**

The development of a Requirements and Management Plan (RMP) for each project should be standard operating procedure; an RMP outlines requirements and contains draft elements of the Project Management Plan (PMP). Sustainable design & high performance green building design goals need to be identified and included in the RMP and progress measured at each project phase.

#### **Planning / Pre-Design**

Site Selection, Scope Definition and Budgeting: Project site selection, scope definition and budgeting are critical factors that contribute positively to success or present additional difficulties that must be solved. Project site selection should maximize future mission flexibility and comply with the Installation Master Plan goals. In practice, this means avoiding green-field sites and select infill sites or building reuse wherever possible. This practice also minimizes ecological damage and preserves resources by making best use of existing infrastructure. In many cases, from an overall sustainability perspective, it is preferred to renovate an existing building rather than to construct a new facility.

ACC Building Commissioning: Processes are detailed in the following sections however some consideration should be made in the Planning / Pre-Design stage as to what level of Building Commissioning will be required. For projects that have already been programmed and funded, implement Fundamental Commissioning of the Building Energy Systems (Energy and Atmosphere, Prerequisite 1).

USGBC LEED-Online Registration: All new vertical construction projects (with climate controls) and major renovation projects (with climate controls) should be registered in the USGBC LEED On-line system during the Planning/Pre-Design or Schematic Design stage. Registering the project is a key component in the ACC sustainable design & high performance green building

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics**

program as it allows the design team access to importance design tools and establishes a consistent project reporting structure.

USGBC LEED Online Data Format: To standardize data entry and to simplify database searches it is critical to use the following conventions when entering project information in the USGBC LEED On-line forms. In the Project Summary section, for:

- “Owner Name” enter “US Air Force”
- “Project Address” enter “Installation Name AFB” (example, Barksdale AFB, Langley AFB)
- “Project Name” enter “Project Name (FYXX)”
- “Organization” enter owning MAJCOM, typically this will be “ACC”
- When queried “Is Project Confidential?” enter “No” unless project has been classified

**Schematic Design**

Each project brings with it a unique set of design considerations and it is important for the decision makers, design team and other stakeholders to work together throughout the life of the project to evaluate priorities, costs versus benefits tradeoffs and sustainable design & high performance green building goals. This integrated approach is also known as building optimization.

Building optimization includes reviewing entire building systems, their relationship to one another and long-term operations and maintenance lifecycle costs. This type of systems approach draws on strengths from each design discipline and includes user input in terms of how the building will be operated, how it will be maintained and where things can be done differently. The project team places a premium on efficient use of space, flexibility, systems analysis and other design tools to optimize the design while saving energy and reducing the environmental impact of the building. Sustainable design and high performance green building principles also contribute to an increase in occupant comfort and health, which increases employee productivity and in turn allows for better business conditions.

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics****Site Sustainability**

The following parallels the ACC Scorecard format and serves to explain what each identified line item requires, provides guidance on implementation and describes how the requirement will be measured. In many instances there is an exact or parallel USGBC LEED® credit associated with the identified line item and where this occurs, the relationship is identified. For a comprehensive discussion on requirements and metrics associated with LEED® credits, refer to published USGBC guidance documents and publications.

**Achieve Pre-Development Hydrology.** Projects with a footprint greater than 5,000 square feet shall use site planning, design, construction, and maintenance strategies to maintain or restore predevelopment hydrology with regards to temperature, rate, volume [quantity], and duration of flow.

Implementation: Attention to site development issues affecting stormwater is required; look at strategies to reduce the Project footprint (building and impervious surfaces) and means to increase water infiltration. Consider pervious paving materials, stormwater harvesting, green roofs, bioswales/vegetated filter strips, retention ponds and clustering development to reduce paved surfaces.

Associated USGBC LEED® Credits: None, however the goal and intent closely aligns with requirements established in Sustainable Sites Credit SS6.1, Stormwater Management (Quantity Control) *and* Sustainable Sites Credit SS6.2, Stormwater Management (Quality Control).

**Construction Activity Pollution Prevention.** Reduce pollution from construction activities by controlling soil erosion, waterway sedimentation and airborne dust generation.

Implementation: Create and implement an Erosion and Sedimentation Control (ESC) plan for all construction activities associated with the Project. The Plan shall describe measures implemented to accomplish the following objectives: prevent loss of soil during construction by stormwater runoff and/or wind erosion (including protecting topsoil by stockpiling for future reuse); prevent sedimentation of storm sewer or receiving streams; and prevent polluting the air with dust and particulate matter.

Associated USGBC LEED® Credits: Sustainable Sites Prerequisite 1, Construction Activity Pollution Prevention.

**Stormwater Design, Quantity Control.** Limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, and managing stormwater runoff.

Implementation: When Project scope includes site work, employ design and construction strategies that reduce the amount of storm water runoff. Consider pervious paving materials, stormwater harvesting, green roofs, bioswales/vegetated filter strips, retention ponds and clustering development to reduce paved surfaces.

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics**

Associated USGBC LEED® Credits: Sustainable Sites Credit SS6.1, Stormwater Management (Quantity Control).

**Stormwater Design, Quality Control.** Limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, eliminating sources of contaminants and removing pollutants from stormwater runoff.

Implementation: Put in place a stormwater management plan that reduces impervious cover, promotes infiltration and captures and treats the stormwater runoff from 90-percent of the average annual rainfall using acceptable best management practices (BMP). Federal policy or directive requirements for stormwater quality control do not align precisely with the USGBC LEED® credit; however, the goals and intent are the same. Air Combat Command considers this best practice and will implement in High Performance Green Buildings.

Associated USGBC LEED® Credits: Sustainable Sites Credit SS6.2, Stormwater Management (Quality Control).

**Heat Island Effect, Roof.** Reduce heat islands to minimize impact on local climate and reduce heat gain internal to the building.

Background: Roofing design is a critical area in building design and construction. Decisions made on materials, systems and geometry will affect the project for the entire life-cycle of the facility and impact every design discipline and building trade. It is important to consider long term solutions and preferred solutions will install systems with long life-cycles and low ongoing maintenance cost.

Implementation: Install high-albedo roofing systems with a Solar Reflectance Index (SRI) > 78 for roof slopes less than/equal to 2:12 and SRI > 29 for roof slopes greater than 2:12. Coordinate roof system design with other Air Combat Command design directives.

Associated USGBC LEED® Credits: Sustainable Sites Credit SS7.2, Heat Island Effect, Roof.

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics****Water Efficiency**

The following parallels the ACC Scorecard format and serves to explain what each identified line item requires, provides guidance on implementation and describes how the requirement will be measured. In many instances there is an exact or parallel USGBC LEED® credit associated with the identified line item and where this occurs, the relationship is identified. For a comprehensive discussion on requirements and metrics associated with LEED® credits, refer to published USGBC guidance documents and publications.

**Water Use Reduction, 20% Reduction.** Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems. Per EPA Act Sec 109, when potable water is used to improve a building's energy efficiency, employ lifecycle cost effective water conservation measures.

Implementation: Employ strategies that in aggregate use a minimum of 20-percent less potable water than the baseline calculations for typical water usage. Investigate methods to reduce potable water consumption including the use of ultra-low flow fixtures, waterless urinals, captured rainwater, high efficiency fixtures, etc. Specify EPA's WaterSense-labeled products or other water conserving products. Refer to the Federal Energy Management Program (FEMP) publication *Domestic Water Conservation Technologies* (located at <http://www1.eere.energy.gov/femp/pdfs/22799.pdf>) for useful design and planning information.

Associated USGBC LEED® Credits: Water Efficiency Prerequisite 1, Water Use Reduction (20-percent).

**Water Efficient Landscaping, Reduce by 50%.** Limit or eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the Project site, for landscape irrigation.

Implementation: When Project scope includes site work, investigate the use of water efficient landscape and irrigation strategies, including water reuse and recycling, with the goal of reducing potable water use by a minimum of 50-percent over that consumed by conventional means (plant species and plant densities). Specify EPA's WaterSense-labeled products or other water conserving products. Investigate use of xeriscaping, native plant selection, grading for landscape water efficiency, etc – in other words, primary design consideration should be for landscapes that do not need to be irrigated in the first place.

Associated USGBC LEED® Credits: Water Efficiency Credit WE1.1, Water Efficient Landscaping (Reduce by 50-percent).

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
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**Water Efficient Landscaping, No Potable Water Use or No Irrigation.** Eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the Project site, for landscape irrigation.

Implementation: Perform a soil/climate analysis to determine appropriate types and design the landscape with indigenous plants to reduce or eliminate irrigation requirements. Consider strategies using captured stormwater, graywater and/or condensate water for irrigation.

Associated USGBC LEED® Credits: Water Efficiency Credit WE1.2, Water Efficient Landscaping (No Potable Water Use or No Irrigation).

## ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics

### Energy & Atmosphere

The following parallels the ACC Scorecard format and serves to explain what each identified line item requires, provides guidance on implementation and describes how the requirement will be measured. In many instances there is an exact or parallel USGBC LEED® credit associated with the identified line item and where this occurs, the relationship is identified. For a comprehensive discussion on requirements and metrics associated with LEED® credits, refer to published USGBC guidance documents and publications.

**Achieve “Designed to Earn the Energy Star” Rating.** Achieve the “Designed to Earn Energy Star” rating.

Implementation: The “Designed to Earn the Energy Star” program is administered by the Environmental Protection Agency (EPA); analysis of the design shall be accomplished using the “Target Finder” program and achieve a rating of 75 or higher. Results of the “Target Finder” analysis shall be submitted to the EPA for review; once accepted by the EPA they will provide the Architect of Record an electronic file with the “Designed to Earn the Energy Star” graphic. The Architect of Record shall place this graphic in the title block on all construction drawings and on the cover of all Contract Documents. Complete “Designed to Earn the Energy Star” information and requirements can be found at the EPA Energy Star website at:

[www.energystar.gov/index.cfm?c=new\\_bldg\\_design.new\\_bldg\\_design\\_benefits](http://www.energystar.gov/index.cfm?c=new_bldg_design.new_bldg_design_benefits)

Associated USGBC LEED® Credits: None; however there may be synergy with Energy and Atmosphere Credit EA1, Minimum Energy Performance.

**Solar Hot Water Heater System – minimum 30% Demand.** Reduce reliance on transmitted/transported power sources used for creating hot water and provide minimum 30-percent of the hot water demand for the building using a solar hot water heater system.

Implementation: Investigate life-cycle cost effectiveness of using solar hot water heater system to provide minimum 30-percent of the hot water demand for the facility (note that this will likely have up-front cost impact and must be investigated/validated during project programming phase). Default should be inclusion of a Solar Hot Water System in the project unless documented that it is not life cycle cost effective; document and maintain information in the project record.

Associated USGBC LEED® Credits: None; however there may be synergy with Energy and Atmosphere Credit EA2, On-Site Renewable Energy. This LEED® credit is based on a reduction in building annual energy cost by employing various on-site renewable energy systems. There is not a direct correspondence between solar hot water production and reduced energy costs, however, a linkage can be made by demonstrating energy savings produced by the solar hot water system in terms of percentage of annual energy cost. The minimum threshold for this LEED® credit is 1% of the building annual energy cost.



## ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics

**Install Advance Metering.** Install advanced utility metering including electrical, natural gas, water and steam (as applicable) to allow consumption tracking and performance optimization.

Implementation: Install advanced utility metering for electrical, natural gas, water and steam (as applicable) systems. During facility operation, additional requirements for tracking and recording consumption come into effect; advanced metering will assist in gathering data for input into EPA's *Portfolio Manager* (or other tool) to track and assess energy and water consumption within individual buildings (this tool can be used across an entire building portfolio as well). Performance goal is for the building to be within 10% of the original design energy target. *Portfolio Manager* is used to benchmark building energy performance, assess energy management goals over time, and identify strategic opportunities for savings and recognition opportunities. Refer to EPA's instructions and use guidelines. Contact ACC/A7OE for additional guidance.

Associated USGBC LEED® Credits: None.

**Reduction in Fossil Fuel-Generated Energy Consumption.** Buildings shall be designed so that the fossil fuel-generated energy consumption of the building is reduced.

Implementation: This is a placeholder Implementation Action. DOE has not completed rulemaking for means/measures.

Associated USGBC LEED® Credits: Unknown.

**Data Center Energy Consumption.** Comply with performance standards, construction and operations specifications, best practices, and benchmarks established in DOE/EPA Data Center Program.

Implementation: This is a placeholder Implementation Action. DOE and EPA have not completed rulemaking for means/measures.

Associated USGBC LEED® Credits: Unknown.

**Reduce Energy Consumption Levels by at Least 30%.** Achieve increased level of energy performance above baseline model to reduce environmental and economic impacts associated with excessive energy use. Achieve a minimum 30-percent improvement over baseline building energy consumption levels using the Department of Energy (DOE) calculations contained in CFR Title 10 Part 433.

Background: There are two competing energy reduction measures directed towards federal agencies – these measures are contained in the MOU and EPA Act. The MOU requires agencies to “...reduce the energy cost budget by 30 percent compared to the baseline building ” and EPA Act requires agencies to “...achieve energy consumption levels...that are at least 30 percent below the levels of the baseline building...” The energy cost budget takes into account energy pricing (subject to great fluctuations) whereas the consumption measure does not. Air Combat

### **ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics**

Command has determined that meeting the EAct 30-percent energy consumption level reduction will assure compliance with the MOU 30-percent energy cost budget requirement, but not vice versa. Therefore, ACC energy reduction implementation will be via compliance with the public law requirements in EAct 2005 and the CFR.

Implementation: Perform whole building energy simulation using the Building Performance Rating Method in ASHRAE 90.1 Appendix G.

Energy efficiency calculations for Federal facilities have been established by the Department of Energy (DOE) in CFR Title 10 Part 433. Mandated minimum is 30-percent improvement over baseline building energy consumption levels using the Performance Rating Method found in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1–2004, Energy Standard for Buildings Except Low-Rise Residential Buildings, **EXCEPT** the formula for calculating the Performance Rating in paragraph G1.2 is changed (for federal Agencies) to read:

***“Percent improvement = 100 x (Baseline building consumption - Proposed building consumption) / (Baseline building consumption - Receptacle and process loads)”***

It cannot be over-emphasized that that the LEED® EA1 credit calculation is similar to the CFR Title 10 Part 433 calculation. The critical difference is that the CFR calculation removes receptacle and process loads while the LEED® calculation does not.

If it is determined through life-cycle cost analysis that the 30-percent improvement cannot be achieved, successive life-cycle cost analyses at 5-percent lower levels shall be completed to determine an achievable improvement. Any improvement less than 30-percent requires specific ACC/A7PS and ACC/A7OE notification, review and concurrence. Stated Air Force and Air Combat Command policy is that Project scope shall be reduced if necessary to meet mandated sustainability goals. Document and maintain the efficiency improvement percentage in the Project record.

Strategies reducing energy consumption must be well explored and documented in the required Project Sustainable Design & High Performance Green Design Analysis (SD&HPGD Analysis).

Once the CFR calculations have been completed and percent improvement determined, perform a second series of calculations using USGBC LEED® Energy and Atmosphere Prerequisite 2, Minimum Energy Performance *and* LEED® Energy and Atmosphere, Credit EA1 (Optimize Energy Performance) calculations. It must be noted that this second calculation does not require additional whole building energy simulation modeling.

Associated USGBC LEED® Credits: Energy and Atmosphere Prerequisite 2, Minimum Energy Performance *and* Energy and Atmosphere Credit EA1, Optimize Energy Performance (as noted).

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics**

**Fundamental Commissioning of the Building Energy Systems.** Fundamental Commissioning requirements as defined by USGBC LEED® are covered by broader Air Combat Command Building Commissioning activities (refer to Innovation/Process section).

Associated USGBC LEED® Credits: Energy and Atmosphere Prerequisite 1, Fundamental Commissioning of the Building Energy Systems.

**Minimum Energy Performance.** Refer to “**Reduce Energy Consumption Levels by at Least 30%**”; for detailed discussion and Implementation actions. Once CFR calculation has been completed and percent improvement determined, perform second calculation using USGBC LEED® Energy and Atmosphere Prerequisite 2, Minimum Energy Performance *and* LEED® Energy and Atmosphere, Credit EA1 (Optimize Energy Performance) calculations.

Associated USGBC LEED® Credits: Energy and Atmosphere Prerequisite 2, Minimum Energy Performance.

**Fundamental Refrigerant Management.** Eliminate the use of ozone depleting compounds during and after construction.

Implementation: Zero use of CFC-based refrigerants in new HVAC&R systems is allowed. When reusing existing HVAC&R equipment, complete a comprehensive CFC phase-out conversion prior to Project completion.

Associated USGBC LEED® Credits: Energy and Atmosphere Prerequisite 3, Fundamental Refrigerant Management.

**Optimize Energy Performance.** Refer to “**Reduce Energy Consumption Levels by at Least 30%**” for discussion and Implementation actions. Once CFR calculation has been performed and percent improvement determined, perform second calculation using USGBC LEED® Energy and Atmosphere Prerequisite 2, Minimum Energy Performance *and* LEED® Energy and Atmosphere, Credit EA1 (Optimize Energy Performance) calculations.

Associated USGBC LEED® Credits: Energy and Atmosphere Credit EA1, Optimize Energy Performance.

**Enhanced Commissioning.** Enhanced Commissioning requirements, as defined by USGBC LEED®, may be covered by broader Air Combat Command Building Commissioning activities (refer to Innovation/Process section).

Associated USGBC LEED® Credits: Energy and Atmosphere Credit EA3, Enhanced Commissioning.

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics**

**Enhanced Refrigerant Management.** Eliminate the use of ozone depleting compounds and support early compliance with the Montreal Protocol.

Implementation: Zero use of CFC-based refrigerants. Select refrigerants and HVAC&R systems that minimize or eliminate the emission of compounds that contribute to ozone depletion and global warming. Federal policy or directive requirements for refrigerant management do not align precisely with the USGBC LEED® credit; however, the goals and intent are the same. Air Combat Command considers this best practice and will implement in High Performance Green Buildings.

Associated USGBC LEED® Credits: Energy and Atmosphere Credit EA4, Enhanced Refrigerant Management.

## ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics

### Materials and Resources

The following parallels the *ACC Scorecard* format and serves to explain what each identified line item requires, provides guidance on implementation and describes how the requirement will be measured. In many instances there is an exact or parallel USGBC LEED® credit associated with the identified line item and where this occurs, the relationship is identified. For a comprehensive discussion on requirements and metrics associated with LEED® credits, refer to published USGBC guidance documents and publications.

**Preferential use of EPA-designated Recovered Materials Products.** Make preferential product/item selections from sources containing recycled content; primary selection should be made from EPA-designated products. Additionally, make preferential selection of products/items with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the Project.

Background: Preferential use of products made with recovered materials is established in the Utilization Resource Conservation and Recovery Act (RCRA) Section 6002. The EPA is required to designate products that are or can be made with recovered materials, and to recommend practices for buying these products. Once a product is designated, federal Agencies are required to purchase it with the highest recovered material content level practicable. The EPA has published and maintains the Comprehensive Procurement Guidelines (CPG) to assist in product/item selections. Detailed information on the EPA Comprehensive Procurement Guidelines (CPG) can be found at: [www.epa.gov/cpg/](http://www.epa.gov/cpg/)

EPA-designated recovered materials products are measured using different criteria than that used in the LEED® Credit MR4.1. The LEED® credit distinguishes between pre-consumer and post-consumer content, whereas EPA-designated products consider post-consumer content and “recovered materials” content. Additionally, the LEED® credit measures recycled content percentage based on cost while the EPA-designated products use recycled content based on weight.

The EPA has designated, or is proposing to designate, products in the following eight categories:

- Construction Products
- Landscaping Products
- Non-paper Office Products
- Paper Products
- Park and Recreation Products
- Transportation Products
- Vehicular Products
- Miscellaneous Products

**Implementation:** Project Teams shall review and edit contract requirements as necessary so they include provisions for selection and use of recovered and recycled-content products and make specific reference to materials and items listed in the *Comprehensive Procurement Guidelines (CPG)*. Additionally, the requirement for

### **ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics**

federal agencies to use and to make preferential selection from products with recovered and recycled content extends into facility operations and maintenance.

Associated USGBC LEED® Credits: None, however the goal and intent closely align with requirements established in Materials and Resources Credit MR4.1, Recycled Content 10% (Post-Consumer + 1/2 Pre-Consumer).

**Preferential use of USDA-designated Biobased Materials Products.** Make preferential product/item selections from USDA-designated biobased products.

Background: The USDA defines biobased products as "*commercial or industrial products (other than food or feed) that are composed in whole or in significant part of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials*". Preferential acquisition and use of biobased products has been codified in the FAR and in the Federal Biobased Products Preferential Purchasing Program (FB4P) under authority of the Farm Security and Rural Investment Act of 2002, Section 9002. USDA-designated biobased products include, but are not limited to:

- Penetrating lubricants
- Roof coatings
- Water tank coatings
- Adhesive and mastic removers
- Plastic insulating foam
- Composite panels
- Fluid-filled transformers
- Carpets
- Wood and concrete sealers

Implementation: Project Teams shall review and edit contract requirements as necessary so they include provisions for selection and use of USDA-designated biobased products. To qualify for preferential use, USDA-designated biobased products must also be reasonably available, meet performance standards, and be reasonably priced. Additionally, the requirement for federal agencies to use and to make preferential selection from USDA-designated products extends into facility operations and maintenance. Further information and references on the USDA Biobased Products Program can be found at: [www.biopreferred.gov](http://www.biopreferred.gov)

Associated USGBC LEED® Credits: None, however the goal and intent closely aligns with requirements established in Materials and Resources Credit MR6, Rapidly Renewable Materials *and* Materials and Resources Credit MR7, Certified Wood.

**Environmentally Preferable Products.** Make preferential product/item selections from products that have a lesser or a reduced effect on human health and the environment over their lifecycle when compared with competing products or services that serve the same purpose.

Implementation: A number of standards and eco-labels are readily available in the marketplace to assist in making environmentally preferable decisions. Project Teams

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics**

shall review and edit contract requirements as necessary so Projects incorporate use of environmentally preferable products. Further information and references can be found in the Federal Green Construction Guide at: [www.wbdg.org/design/greenspec.php](http://www.wbdg.org/design/greenspec.php)

Associated USGBC LEED® Credits: None.

**Storage & Collection of Recyclables.** Facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.

Implementation: Provide an easily accessible area that is dedicated to the collection and storage of non-hazardous materials for recycling including (at a minimum) paper, corrugated cardboard, glass, plastics and metals. Include, and designate, this space at all design stages. Coordinate the size and functionality of the recycling areas with the anticipated collection services to maximize effectiveness. To further enhance the recycling program consider employing cardboard balers, aluminum can crushers and recycling chutes; at a minimum provide distributed collection bins located in the vicinity of individual workstations. Coordinate with Installation wide service contract providers and obtain sufficient collection services.

Associated USGBC LEED® Credits: Materials and Resources Prerequisite 1, Storage & Collection of Recyclables.

**Construction Waste Management, Divert 50% from Disposal.** Divert construction and demolition debris from disposal in landfills and incinerators. Redirect recyclable recovered resources back into the manufacturing process. Redirect reusable materials to appropriate sites.

Implementation: During the Project planning stage, identify local recycling and salvage operations that could process site related waste. Develop and implement a construction waste management plan to recycle or salvage at least 50-percent of construction, demolition and land clearing waste, excluding soil and hazardous materials. Prepare construction documents so that construction waste management plan is mandatory provision; during construction, ensure plan is followed and goals achieved.

Associated USGBC LEED® Credits: Materials and Resources Credit MR2.1, Construction Waste Management, Divert 50% from Disposal.

**Recycled Content 10% (Post-Consumer + 1/2 Pre-Consumer).** At a minimum, establish a project goal for the use of recycled content materials equal to 10% of the total materials cost in the project. During design phases, identify and select products and suppliers that will help achieve this goal.

Background: this LEED® credit is similar to the Federal Agency requirement discussed above "Preferential use of USDA-designated Biobased Materials Products" however there are some

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics**

basic differences. The LEED® credit distinguishes between pre-consumer and post-consumer content, whereas EPA-designated products consider post-consumer content and “recovered materials” content. Additionally, the LEED® credit measures recycled content percentage based on cost while the EPA-designated products use recycled content based on weight.

Implementation: Air Combat Command construction projects shall actively seek to increase the demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials. During construction, ensure selected products are installed. The goal and intent of this LEED® credit closely aligns with higher requirements for the preferential product/item selections from sources containing recycled content and is to be incorporated in Air Combat Command projects even if total quantities do not meet LEED® thresholds.

Associated USGBC LEED® Credits: Materials and Resources Credit MR4.1, Recycled Content 10% (Post-Consumer + 1/2 Pre-Consumer).

**Rapidly Renewable Materials.** Reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials.

Implementation: Establish a project goal for the use of rapidly renewable materials. Select products and identify suppliers that will help achieve this goal. Consider materials such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheatboard, strawboard and cork. During construction, ensure selected products are installed. The goal and intent of this LEED® credit closely aligns with higher requirements for the preferential product/item selections of rapidly renewable products and is to be incorporated in Air Combat Command projects even if total quantities do not meet LEED® thresholds.

Associated USGBC LEED® Credits: Materials and Resources Credit MR6, Rapidly Renewable Materials.

**Certified Wood.** Encourage environmentally responsible forest management.

Implementation: Establish a project goal for the use of certified wood including, but not limited to structural framing and general dimensional framing, flooring, sub-flooring, wood doors and wood trim. Select products and identify suppliers that will help achieve this goal. During construction, ensure selected products are installed. The goal and intent of this LEED® credit closely aligns with higher requirements for the use of certified wood products and is to be incorporated in Air Combat Command projects even if total quantities do not meet LEED® thresholds.

Associated USGBC LEED® Credits: Materials and Resources Credit MR7, Certified Wood.



## ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics

### Indoor Environmental Quality

The following parallels the ACC Scorecard format and serves to explain what each identified line item requires, provides guidance on implementation and describes how the requirement will be measured. In many instances there is an exact or parallel USGBC LEED® credit associated with the identified line item and where this occurs, the relationship is identified. For a comprehensive discussion on requirements and metrics associated with LEED® credits, refer to published USGBC guidance documents and publications.

**Establish Moisture Control Strategy.** Establish and implement a moisture control strategy for controlling moisture flows and condensation to prevent building damage, minimize mold contamination, and reduce health risks related to moisture.

Background: Moisture control is an often overlooked issue; however, failing to properly address this topic can lead to significant health-related concerns and needless waste of the building's heating and cooling energy. Refer to the National Institute of Standards and Technology (NIST) publication *Investigation of the Impact of Commercial Building Envelope Airtightness on HVAC Energy Use* (located at <http://www.fire.nist.gov/bfrlpubs/build05/art007.html>) for useful design and planning information. This study predicts potential annual heating and cooling energy cost savings ranging from 3-percent to 36-percent if properly implemented.

Recent work by the Corps of Engineers (COE) on Building Air Tightness Performance Requirements also addresses this issue. The COE has set requirements for air barrier material(s) to have an air permeance not to exceed 0.004 cfm / sf at 0.3" wg [0.02 L/s.m<sup>2</sup> @ 75 Pa] when tested in accordance with ASTM E 2178. This requirement shall be incorporated in Air Combat Command projects.

Implementation: In project documents, establish Building Air Tightness requirements to fully incorporate performance measures and required remediation measures if performance is not initially obtained. Strategies must be well explored and documented in the required Project Sustainable Design & High Performance Green Design Analysis (SD&HPGD Analysis). Discuss these requirements at all project design and construction meetings including pre-bid and kickoff. During construction, ensure designed measures are properly installed and tested.

**Building Air Tightness Performance Requirements:** Design and construct the building envelope with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components. Clearly identify the boundary limits of the building air barriers, and of the zone or zones to be tested for building air tightness on the drawings. Trace a continuous plane of air-tightness throughout the building envelope. Make the building envelope flexible and seal all moving joints.

Associated USGBC LEED® Credits: None directly; however there will be significant energy savings realized and possible synergies with Energy and Atmosphere Credit EA1, Optimize Energy Performance.

## **ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics**

**Minimum IAQ Performance.** Establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of occupants.

Implementation: Design ventilation systems to meet or exceed the minimum outdoor air ventilation rates per ASHRAE 62.1, *Ventilation for Acceptable Indoor Air Quality*. Balance the impacts of ventilation rates on energy use and indoor air quality to optimize energy efficiency and occupant health.

Associated USGBC LEED® Credits: Indoor Environmental Quality Prerequisite.1, Minimum IAQ Performance.

**Environmental Tobacco Smoke (ETS) Control.** Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to Environmental Tobacco Smoke (ETS).

Implementation: Prohibit smoking in the building and locate any exterior designated smoking areas at least 25-feet away from entries, outdoor air intakes and operable windows.

Associated USGBC LEED® Credits: Indoor Environmental Quality Prerequisite 2, Environmental Tobacco Smoke (ETS) Control.

**Construction IAQ Management Plan, During Construction and Before Occupancy.** Reduce indoor air quality problems by addressing issues during construction/renovation work *and* before building occupancy in order to help sustain the comfort and well-being of construction workers and building occupants.

Implementation: Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases which at a minimum includes: following the recommended Control Measures of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) *IAQ Guidelines for Occupied Buildings under Construction*; protecting stored on-site or installed absorptive materials from moisture damage and replacing all air filtration media immediately prior to occupancy.

After construction and prior to occupancy, meet USGBC LEED® Indoor Environmental Quality Credit EQ3.2, Construction IAQ Management Plan (Before Occupancy) requirements by either conducting a building air flush-out or performing air quality testing and demonstrating that contaminants maximum concentrations are not exceeded. Federal policy or directive requirements address flush-out and do not align precisely with the USGBC LEED® credit; however, the goals and intent are the same. Air Combat Command considers this best practice and will implement in High Performance Green Buildings.

Associated USGBC LEED® Credits: Indoor Environmental Quality Credit EQ3.1, Construction IAQ Management Plan (During Construction) *and* Indoor Environmental Quality Credit EQ3.2, Construction IAQ Management Plan (Before Occupancy).

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics**

**Low-Emitting Materials.** Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of construction workers and building occupants.

Implementation: In project documents, specifically call attention to the requirement for low-emitting products/items. Make preferential selections from products/items with low pollutant emissions with specific attention to adhesives and sealants, paints and coatings, carpet-systems, composite wood and agrifiber products and furnishing selections. During construction, verify specified materials are installed. Implementing these requirements should be straightforward as many manufacturers are already addressing the concern with harmful/irritating emissions and making changes to their products.

Associated USGBC LEED® Credits: Indoor Environmental Quality Credits EQ4.1, Low-Emitting Materials- Adhesives & Sealants; EQ4.2, Low-Emitting Materials- Paints & Coatings; EQ4.3, Low-Emitting Materials- Flooring Systems and EQ4.4, Low-Emitting Materials- Composite Wood & Agrifiber Products.

**Controllability of Systems, Lighting.** Provide a high level of lighting system control by individual occupants or by specific groups in multi-occupant spaces (i.e. classrooms, conference rooms) to promote the productivity, comfort and well-being of building occupants.

Implementation: Design the building with occupant controls for lighting. Strategies to consider include lighting controls, utilization of task lighting vice general illumination and provisions for daylighting (with provisions to prevent glare). Integrate lighting systems controllability into the overall lighting design, providing ambient and task lighting while managing the overall energy use of the building. Consider use of automatic lighting dimming controls to reduce artificial lighting levels when adequate natural daylight is present. Federal policy or directive requirements for controllability of lighting systems do not align precisely with the USGBC LEED® credit; however, the goals and intent are the same. Air Combat Command considers this best practice and will implement in High Performance Green Buildings.

Associated USGBC LEED® Credits: Indoor Environmental Quality Credits EQ6.1, Controllability of Systems (Lighting).

**Thermal Comfort, Design.** Provide a comfortable thermal environment that supports the productivity and well-being of building occupants.

Implementation: Design HVAC systems and the building envelope to meet requirements of ASHRAE Standard 55, *Thermal Comfort Conditions for Human Occupancy*. Evaluate air temperature, radiant temperature, air speed and relative humidity in an integrated fashion.

Associated USGBC LEED® Credits: Indoor Environmental Quality Credits EQ7.1, Thermal Comfort (Design).

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics**

**Daylight & Views, Daylight 75% of Spaces.** Provide for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas.

Implementation: Daylight levels may be determined by glazing factor calculation, daylight simulation modeling or through daylight measurements. Achieving daylight and views for building occupants should be a high priority goal in all projects but may be difficult to achieve due to some mission function. Recent successful design strategy has been to locate open office workstations along perimeter walls and place the private offices towards the building interior; the private offices have sidelights, vision panel doors and in some cases transom windows which allows daylight into these spaces. As an absolute minimum, projects should not create windowless offices or windowless regularly occupied spaces unless specifically required by mission-related tasks. In cases where security considerations or mission-related tasks would prohibit windows for views, the integrated project team must still investigate scenarios allowing natural daylighting into these spaces. Strategies must be well explored and documented in the required Project Sustainable Design & High Performance Green Design Analysis (SD&HPGD Analysis). Additionally, the project design should provide daylight redirection and/or glare control devices and automatic dimming controls or accessible manual lighting controls. Creation of windowless offices or windowless regularly occupied spaces may happen only after review and approval from ACC/A7PS; document and maintain this information in the project record.

Associated USGBC LEED® Credits: Indoor Environmental Quality Credit EQ8.1, Daylight and Views (Daylight 75% of Spaces).

**ACC Sustainable Design & High Performance Green Building (SD&HPGB)  
Interim Implementation Actions and Metrics****Innovation/Processes**

The following parallels the ACC Scorecard format and serves to explain what each identified line item requires, provides guidance on implementation and describes how the requirement will be measured. In many instances there is an exact or parallel USGBC LEED® credit associated with the identified line item and where this occurs, the relationship is identified. For a comprehensive discussion on requirements and metrics associated with LEED® credits, refer to published USGBC guidance documents and publications.

*Note: It may be possible that with proper documentation some of the Federal Agency requirements could qualify as LEED Innovation in Design credits. Design teams are encouraged to pursue this possibility.*

**Integrated Planning/Design Team.** Use a collaborative, integrated planning and design process that: initiates and maintains an integrated Project team in all stages; works holistically to resolve issues; considers best approaches to achieving high performance green goals for siting, energy, water, materials, and indoor environmental quality along with other comprehensive design goals and ensures incorporation of these goals throughout the design and lifecycle of the building.

Implementation: Requires assembly of integrated Project delivery team gathered at initial Project planning stage. The team must establish goals for Project siting, energy usage, water conservation, indoor environmental quality and materials use. The team must integrate requirements in OMB Publication A-11, Part 7, Exhibit 300: *Capital Asset Plan and Business Case Summary* and must consider all stages of the building's lifecycle, including deconstruction.

Associated USGBC LEED® Credits: None.

**Project Case Study Entered in High Performance Federal Buildings Database.** Air Combat Command supports the widest dissemination of high performance green design practices and believes open communication will lead to rapid adoption and implementation. To support this goal, all Air Combat Command projects selected for full USGBC review and certification will be entered into the High Performance Federal Buildings database.

Implementation: The High Performance Federal Buildings Database is sponsored by the U.S. Department of Energy, Federal Energy Management Program (FEMP). It seeks to improve building performance measuring methods by collecting data on various factors including energy, materials, and land use. There are three steps in the process- the first is to register and open an account with FEMP; the second is to enter the Project information and the third is a FEMP review and public posting. The FEMP website is at: <http://femp.buildinggreen.com/>

Associated USGBC LEED® Credits: None.

## **ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics**

**ACC Building Commissioning.** Building commissioning activities constitute quality assurance. Commissioning is an integrated process for achieving, validating and documenting performance of the building and its systems relative to the design intent and Project requirements. Building commissioning recognizes the integrated nature of all building systems' performance, which impact sustainability, workplace productivity, and occupant safety, health and security. A holistic approach will safeguard Air Combat Command interests and investments by implementing solutions that best represent and meet long term efficiency and functionality goals while meeting mission requirements; improve facility operations; optimize value received for each construction dollar spent and improve Indoor Environmental Quality (IEQ).

Because all building systems are integrated, a deficiency in one or more components can result in suboptimal operation and performance among other components. Remedying these deficiencies can result in a variety of benefits including:

- Improved building occupant productivity
- Lower utility bills through energy savings
- Increased occupant satisfaction
- Enhanced environmental/health conditions and occupant comfort
- Improved system and equipment function
- Improved building operation and maintenance
- Increased occupant safety
- Better facility documentation
- Shortened occupancy transition period
- Significant extension of equipment/systems life cycle

Air Combat Command is establishing three broad tiers of commissioning activities tailored to the size and complexity of the building and its system components: 'ACC Fundamental Commissioning'; 'ACC Enhanced Commissioning' and 'ACC Commissioning for HVAC&R Start-up and Turnover' (applicable only to Projects consisting of HVAC&R system upgrades). All buildings shall be commissioned at either the 'ACC Fundamental Commissioning' level or the 'ACC Enhanced Commissioning' level. The transition threshold between ACC Fundamental Commissioning and ACC Enhanced Commissioning is established when:

Primary Facility cost is \$10M and over. ACC Enhanced Commissioning may also be undertaken on smaller projects if it is expected to meet investment criteria as determined at the Customer Project Requirements (CPR) stage, or if it is otherwise appropriate given the nature of the project.

**ACC Fundamental Commissioning Implementation:** Begin commissioning processes in the Planning/Pre-Design stage. Processes listed below comply with both federal agency requirements and the LEED® prerequisite criteria.

1. Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities.
  - a. The CxA shall have documented commissioning authority experience in at least two building projects.
  - b. The individual serving as the CxA shall be independent of the project's design and construction management, though they may be employees of the firms providing those services. The CxA may be a qualified employee of the government.

### **ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics**

- c. The CxA shall report results, findings and recommendations directly to the government.
- d. For projects smaller than 50,000 gross square feet, the CxA may include qualified persons on the design or construction teams who have the required experience.
2. Ensure CxA participation in all design charrettes.
3. The Government shall fully document Project Requirements and the design team shall develop the Basis of Design (BOD). The CxA shall review these documents for clarity and completeness. The Government and the design team shall be responsible for updates to their respective documents.
4. Develop and incorporate commissioning requirements into the construction documents.
5. Develop and implement a commissioning plan.
6. Verify the installation and performance of the systems to be commissioned.
7. Complete a summary commissioning report.

At a minimum, the following core building systems shall be commissioned.

- Heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems and associated controls (mechanical and passive)
- Domestic hot water systems and associated controls
- Renewable energy (wind, solar, etc.) systems and associated controls
- Life safety systems and associated controls
- Lighting and daylighting systems and associated controls
- Emergency power and uninterruptable power systems and associated controls
- Electrical systems, including service switch gear, switchboards, distribution panel boards, transformers, motor control centers, power monitoring and metering, transient voltage surge suppressors, variable speed drives, grounding and ground fault systems, overcurrent protective devices and low voltage busway

Additional systems should be added to the core building systems list when:

The individual system estimated cost is \$500,000 and over  
AND/OR

The system is identified in Customer Project Requirement (CPR) design analysis as of sufficient complexity to be likely to benefit from Commissioning.

Possible additional systems include but are not limited to:

- Building automation systems
- Plumbing systems, including domestic water supply, metering, domestic hot water, irrigation, stormwater, water treatment, and process water pumping and mixing systems
- Equipment sound control systems
- Vertical transport systems
- Laboratory pressurized air and vacuum systems
- Security and access control systems
- Information and communications systems, including voice and data
- Building envelope
- Public address/paging systems

## **ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics**

Associated USGBC LEED® Credits: Energy and Atmosphere Prerequisite 1, Fundamental Commissioning of the Building Energy Systems.

ACC Enhanced Building Commissioning Implementation: Begin commissioning processes in the Planning/Pre-Design stage. Processes listed below comply with federal agency requirements, LEED® Energy and Atmosphere Prerequisite 1 criteria and LEED® Energy and Atmosphere Credit 3, “Enhanced Commissioning” criteria.

1. Prior to the start of the construction documents phase, engage an independent Commissioning Authority (CxA) to lead, review, and oversee the completion of all commissioning process activities. The CxA shall, at a minimum, perform Tasks 3, 4 and 7. Other team members may perform Tasks 5 and 6.
  - a. The CxA shall have documented commissioning authority experience in at least two building projects.
  - b. The individual serving as the CxA shall be independent of the project’s design and construction management. The CxA may be a qualified employee of the government.
  - c. The CxA shall report results, findings and recommendations directly to the Government.
  - d. This requirement has no deviation for project size.
2. Ensure CxA participation in all design charrettes.
3. The Government shall fully document Project Requirements and the design team shall develop the Basis of Design (BOD). The CxA shall review these documents for clarity and completeness. The Government and the design team shall be responsible for updates to their respective documents.
4. Develop and incorporate commissioning requirements into the construction documents.
5. Develop and implement a commissioning plan. Include provisions for the resolution of outstanding commissioning related issues identified at the 10-month building operation review.
6. Verify the installation and performance of systems identified to be commissioned.
7. Complete a summary commissioning report.
8. Perform commissioning design review in conjunction with all design reviews and back-check comment resolution in the subsequent design submission.
9. Review contractor submittals applicable to systems being commissioned. These reviews shall be concurrent with designer reviews.
10. Develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems.
11. Verify that the requirements for training operating personnel and building occupants are completed.
12. Review building operation within 10-months after substantial completion.

At a minimum, the following core building systems shall be commissioned.

- Heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems and associated controls (mechanical and passive)



### **ACC Sustainable Design & High Performance Green Building (SD&HPGB) Interim Implementation Actions and Metrics**

- Domestic hot water systems and associated controls
- Renewable energy (wind, solar, etc.) systems and associated controls
- Life safety systems and associated controls
- Lighting and daylighting systems and associated controls
- Emergency power and uninterruptable power systems and associated controls
- Electrical systems, including service switch gear, switchboards, distribution panel boards, transformers, motor control centers, power monitoring and metering, transient voltage surge suppressors, variable speed drives, grounding and ground fault systems, overcurrent protective devices and low voltage busway
- Building automation systems
- Plumbing systems, including domestic water supply, metering, domestic hot water, irrigation, stormwater, water treatment, and process water pumping and mixing systems
- Equipment sound control systems
- Vertical transport systems
- Laboratory pressurized air and vacuum systems
- Security and access control systems
- Information and communications systems, including voice and data
- Building envelope
- Public address/paging systems

Additional systems should be added when:

The individual system estimated cost is \$500,000 and over  
AND/OR

The system is identified in Customer Project Requirement (CPR) design analysis

Associated USGBC LEED® Credits: Energy and Atmosphere Prerequisite 1, Fundamental Commissioning of the Building Energy Systems *and* Energy and Atmosphere Credit EA3, Enhanced Commissioning.

**LEED® Accredited Professional.** Having LEED accredited professionals on the team will support and encourage design integration and aligns with the integrated team goal.

Implementation: At least one principal participant of the Project team shall be a LEED® Accredited Professional (LEED-AP). Federal policy or directive requirements do not align precisely with the USGBC LEED® credit; however, the goals and intent are the same. Air Combat Command considers this best practice and will implement in High Performance Green Buildings

Associated USGBC LEED® Credits: Innovation & Design Process Credit ID2, LEED Accredited Professional.

END

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX PP

### ACC Sustainable Design & High Performance Green Building Scorecard

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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ACC Sustainable Design & High Performance Green Building Scorecard  
New Construction and Major Renovation Sustainable Implementation Actions  
References are to USGBC LEED® 2009  
Scorecard Form - Sept 2009

Project Name: F-22 ADD/ALT HANGAR BAY

Installation: Langley AFB

Project Number: 0

Date: 30-Apr

Project Phase (see Phase Matrix below): Planning/Pre-Design

Mark with X	Credit/Requirement Description: <i>Federal Agency/ACC Requirement</i> <i>Aligns closely with other Federal Agency requirement(s) (see notes if applicable)</i> <i>Special Implementation (see notes if applicable)</i> All others are LEED® credits not associated with specific Federal Requirements	LEED® Points and Federal Requirements Tracking				Project Phase Matrix (Primary and Secondary)				
		Possible LEED® Points	LEED® Point Tally Follow Up - Future Phases	LEED® Point Tally Targeted - Current Phase	Federal Agency Sustainability Requirements	Planning / Pre-Design	Schematic Design	Construction Documents (100%)	Construction	Post-Construction
<b>Site Sustainability</b>										
X	Achieve Pre-Development Hydrology (EISA 2007, Section 438)	Non-LEED®			No					
X	Prereq 1 Construction Activity Pollution Prevention (MOU, Section III)	LEED® Prereq			No					
	Credit 1 Site Selection	1	0	1		P	S			
	Credit 2 Development Density & Community Connectivity	5	0	0		P	S			
	Credit 3 Brownfield Redevelopment	1	0	0		P	S			
	Credit 4.1 Alternative Transportation, Public Transportation Access	6	0	0		P	S			
	Credit 4.2 Alternative Transportation, Bicycle Storage & Changing Rooms	1	0	1				S		
	Credit 4.3 Alternative Transportation, Low-Emitting & Fuel-Efficient Vehicles	3	0	0		P	S			
	Credit 4.4 Alternative Transportation, Parking Capacity	2	0	2		P	S			
	Credit 5.1 Site Development, Protect or Restore Habitat	1	1	0		P	S			
	Credit 5.2 Site Development, Maximize Open Space	1	1	0		P	S			
	Credit 6.1 Stormwater Design, Quantity Control (MOU, Section III)	1	1	0	No	S	P	S		
	Credit 6.2 Stormwater Design, Quality Control (MOU, Section III)	1	1	0	No	S	P	S		
	Credit 7.1 Heat Island Effect, Non-Roof	1	1	0			P	S		
	Credit 7.2 Heat Island Effect, Roof (1)	1	1	0	No		P	S		
	Credit 8 Light Pollution Reduction	1	1	0		S	P			
LEED® Category Total		7	4							
<b>Water Efficiency</b>										
X	Prereq 1 Water Use Reduction, 20% Reduction (MOU, Section III)	LEED® Prereq			No			S	P	
	Credit 1.1 Water Efficient Landscaping, Reduce by 50% (MOU, Section III)	2	0	2	Yes			S	P	
	Credit 1.2 Water Efficient Landscaping, No Potable Use or No Irrigation (1)	2	0	2	Yes			S	P	
	Credit 2 Innovative Wastewater Technologies	2	2	0				S	P	
	Credit 3 Water Use Reduction, 30% Reduction (Mark only one line)	2 to 4						S	P	
	30% Reduction	2	0	0				S	P	
	35% Reduction	3	0	0				S	P	
	40% Reduction	4	4	0				S	P	
LEED® Category Total		6	4							
<b>Energy &amp; Atmosphere</b>										
X	Achieve "Designed to Earn the Energy Star" rating (MOU, Section II)	Non-LEED®			No			S	P	
X	Solar Hot Water Heater System - min 30% demand (EISA 2007, Section 523) (2)	Non-LEED®			No			P	S	
X	Install Advanced Metering (MOU Section II, EPA 2005 Sec 103, EISA 2007 Sec 434)	Non-LEED®			No			S	P	
	Reduction in fossil fuel-generated energy consumption (EISA 2007, Section 433) (3)	Non-LEED®								
	Data Center Energy Consumption (EISA 2007 Section 453) (4)	Non-LEED®								
	Reduce Energy Consumption Levels by at Least 30% (MOU/EPA 2005/CFR Title 10 Part 433) (5)	Non-LEED®			No			P	S	
	Prereq 1 Fundamental Commissioning of the Building Energy Systems (MOU, Section I) (6)	LEED® Prereq				S	P	S	S	
	Prereq 2 Minimum Energy Performance, 10% New Bldgs or 5% Existing Bldg Renovations (7)	LEED® Prereq					P	S		
	Prereq 3 Fundamental Refrigerant Management (MOU, Section V)	LEED® Prereq			No			S	P	

	Mark with X	Possible Action - Follow Up - Future Phases Planned/Targeted Action - Current Phase	Credit/Requirement Description: Federal Agency/ACC Requirement Aligns closely with other Federal Agency requirement(s) (see notes if applicable) Special Implementation (see notes if applicable) All others are LEED® credits not associated with specific Federal Requirements	LEED® Points and Federal Requirements Tracking				Project Phase Matrix (Primary and Secondary)			
				Possible LEED® Points	LEED® Point Tally Follow Up - Future Phases	LEED® Point Tally Targeted - Current Phase	Federal Agency Sustainability Requirements	Planning / Pre-Design	Schematic Design	Construction Documents (100%)	Post-Construction
Energy & Atmosphere (Cont.)			<b>Credit 1 Optimize Energy Performance (5) (Mark only one line)</b>	1 to 19				P	S		
			12% New Buildings or 8% Existing Building Renovations	1	0	0		P	S		
			14% New Buildings or 10% Existing Building Renovations	2	0	0		P	S		
			16% New Buildings or 12% Existing Building Renovations	3	0	0		P	S		
			18% New Buildings or 14% Existing Building Renovations	4	0	0		P	S		
			20% New Buildings or 16% Existing Building Renovations	5	0	0		P	S		
			22% New Buildings or 18% Existing Building Renovations	6	0	0		P	S		
			24% New Buildings or 20% Existing Building Renovations	7	0	0		P	S		
			26% New Buildings or 22% Existing Building Renovations	8	0	0		P	S		
			28% New Buildings or 24% Existing Building Renovations	9	0	0		P	S		
			30% New Buildings or 24% Existing Building Renovations	10	0	0		P	S		
			32% New Buildings or 28% Existing Building Renovations	11	11	0		P	S		
			34% New Buildings or 30% Existing Building Renovations	12	0	0		P	S		
			36% New Buildings or 32% Existing Building Renovations	13	0	0		P	S		
			38% New Buildings or 34% Existing Building Renovations	14	0	0		P	S		
			40% New Buildings or 36% Existing Building Renovations	15	0	0		P	S		
			42% New Buildings or 38% Existing Building Renovations	16	0	0		P	S		
			44% New Buildings or 40% Existing Building Renovations	17	0	0		P	S		
			46% New Buildings or 42% Existing Building Renovations	18	0	0		P	S		
			48% New Buildings or 44% Existing Building Renovations	19	0	0		P	S		
			<b>Credit 2 On-Site Renewable Energy (Mark only one line)</b>	1 to 7				S	P	S	
			1% Renewable Energy	1	0	0		S	P	S	
			3% Renewable Energy	2	2	0		S	P	S	
			5% Renewable Energy	3	0	0		S	P	S	
			7% Renewable Energy	4	0	0		S	P	S	
			9% Renewable Energy	5	0	0		S	P	S	
			11% Renewable Energy	6	0	0		S	P	S	
			13% Renewable Energy	7	0	0		S	P	S	
			<b>Credit 3 Enhanced Commissioning (6)</b>	2	2	0		P	S	S	S
			<b>Credit 4 Enhanced Refrigerant Management (MOU, Section V)</b>	2	2	0	No			P	S
			<b>Credit 5 Measurement &amp; Verification</b>	3	3	0				P	S
			<b>Credit 6 Green Power</b>	2	2	0		P	S	S	
			<b>LEED® Category Total</b>	<b>22</b>	<b>0</b>						
Materials & Resources			Preferential use of EPA-designated Recovered Materials Products (MOU, Section V)	Non-LEED®			No	S	P		
			Preferential use of USDA-designated Biobased Products (MOU, Section V)	Non-LEED®			No	S	P		
			Environmentally Preferable Products (MOU, Section V)	Non-LEED®			No	S	P		
			<b>Prereq 1 Storage &amp; Collection of Recyclables (MOU, Section V and EO 13423, Section 2E)</b>	LEED® Prereq			No	P	S		S
			<b>Credit 1.1 Building Reuse, Maintain 55% of Existing Walls, Floors &amp; Roof</b>	1	0	0		P	S		
			<b>Credit 1.2 Building Reuse, Maintain 75% of Existing Walls, Floors &amp; Roof</b>	2	0	0		P	S		
			<b>Credit 1.3 Building Reuse, Maintain 95% of Existing Walls, Floors &amp; Roof</b>	3	0	0		P	S		
			<b>Credit 1.4 Building Reuse, Maintain 50% of Interior Non-Structural Elements</b>	1	0	0		P	S		
			<b>Credit 2.1 Construction Waste Management, Divert 50% from Disposal (MOU, Section IV)</b>	1	1	0	No	S	P	S	
			<b>Credit 2.2 Construction Waste Management, Divert 75% from Disposal</b>	1	1	0		S	P	S	
			<b>Credit 3.1 Materials Reuse, 5%</b>	1	0	0		S	P	S	
			<b>Credit 3.2 Materials Reuse, 10%</b>	1	0	0		S	P	S	
			<b>Credit 4.1 Recycled Content, 10% (post-consumer + ½ pre-consumer) (MOU, Section V) (8)</b>	1	1	0	No	S	P	S	
			<b>Credit 4.2 Recycled Content, 20% (post-consumer + ½ pre-consumer)</b>	1	1	0		S	P	S	
			<b>Credit 5.1 Regional Materials, 10% Extracted, Processed &amp; Manufactured Regionally</b>	1	1	0		S	P	S	
			<b>Credit 5.2 Regional Materials, 20% Extracted, Processed &amp; Manufactured Regionally</b>	1	1	0		S	P	S	
			<b>Credit 6 Rapidly Renewable Materials (MOU, Section V) (8)</b>	1	1	0	No	S	P	S	
			<b>Credit 7 Certified Wood (MOU, Section V) (8)</b>	1	1	0	No	S	P	S	
			<b>LEED® Category Total</b>	<b>8</b>	<b>0</b>						



	Mark with X	Credit/Requirement Description: Federal Agency/ACC Requirement Aligns closely with other Federal Agency requirement(s) (see notes if applicable) Special Implementation (see notes if applicable) All others are LEED® credits not associated with specific Federal Requirements	LEED® Points and Federal Requirements Tracking				Project Phase Matrix (Primary and Secondary)				
			Possible LEED® Points	LEED® Point Tally Follow Up - Future Phases	LEED® Point Tally Targeted - Current Phase	Federal Agency Sustainability Requirements	Planning / Pre-Design	Schematic Design	Construction Documents (100%)	Construction	Post-Construction
Indoor Environmental Quality	X	Prereq 1 Establish Moisture Control Strategy (MOU, Section IV)	Non-LEED®			No		P	S		
	X	Prereq 2 Minimum IAQ Performance (MOU, Section IV) (9)	LEED® Prereq			No		P		S	
	X	Prereq 2 Environmental Tobacco Smoke (ETS) Control (EO 13052 and MOU, Section IV)	LEED® Prereq			No		P		S	
	X	Credit 1 Outdoor Air Delivery Monitoring	1	1	0			P		S	
	X	Credit 2 Increased Ventilation	1	1	0		S	P			
	X	Credit 3.1 Construction IAQ Management Plan, During Construction (MOU, Section IV) (10)	1	1	0	No		S	P		
	X	Credit 3.2 Construction IAQ Management Plan, Before Occupancy (MOU, Section IV)	1	1	0	No		S	S	P	
	X	Credit 4.1 Low-Emitting Materials, Adhesives & Sealants (MOU, Section IV)	1	1	0	No	S	P	S		
	X	Credit 4.2 Low-Emitting Materials, Paints & Coatings (MOU, Section IV)	1	1	0	No	S	P	S		
	X	Credit 4.3 Low-Emitting Materials, Flooring Systems (MOU, Section IV)	1	1	0	No	S	P	S		
	X	Credit 4.4 Low-Emitting Materials, Composite Wood & Agrifiber Products (MOU, Section IV)	1	1	0	No	S	P	S		
	X	Credit 5 Indoor Chemical & Pollutant Source Control	1	1	0		S	P	S		
	X	Credit 6.1 Controllability of Systems, Lighting (MOU, Section IV)	1	1	0	No	S	P			
	X	Credit 6.2 Controllability of Systems, Thermal Comfort	1	0	0		S	P			
	X	Credit 7.1 Thermal Comfort, Design (MOU, Section IV)	1	1	0	No	S	P			
		Credit 7.2 Thermal Comfort, Verification	1	0	0		S	P			
		Credit 8.1 Daylight & Views, Daylight 75% of Spaces (MOU, Section IV)	1	0	0	No	P	S			
		Credit 8.2 Daylight & Views, Views for 90% of Spaces	1	0	0		P	S			
LEED® Category Total			11	0							
Innovation/Process	X	Integrated Planning/Design Team (MOU, Section I)	Non-LEED®			No	S	P	S	S	S
	X	Project Case Study Entered in High Performance Building Database (MOU, Section II)	Non-LEED®			No			S		P
	X	ACC Building Commissioning (MOU, Section I) (6)	Non-LEED®			No	P	S	S	S	S
	X	Credit 1.1 Innovation in Design: Provide Specific Title	1	1	0		S	P			
	X	Credit 1.2 Innovation in Design: Provide Specific Title	1	1	0		S	P			
	X	Credit 1.3 Innovation in Design: Provide Specific Title	1	1	0		S	P			
	X	Credit 1.4 Innovation in Design: Provide Specific Title	1	1	0		S	P			
	X	Credit 1.5 Innovation in Design: Provide Specific Title	1	1	0		S	P			
Regional	X	Credit 2 LEED® Accredited Professional (MOU, Section I)	1	0	1	Yes	P	S	S	S	S
LEED® Category Total			5	1							
Regional	X	Credit 1.1 Regional Priority Credit: Region Defined	1	1	0		S	P			
	X	Credit 1.2 Regional Priority Credit: Region Defined	1	1	0		S	P			
	X	Credit 1.3 Regional Priority Credit: Region Defined	1	1	0		S	P			
	X	Credit 1.4 Regional Priority Credit: Region Defined	1	1	0		S	P			
LEED® Category Total			4	0							

LEED® Possible Points 63

LEED® Planned/Targeted Points 9

Project Strategy Meets/Exceeds LEED® Silver Threshold No

Federal Agency/ACC Requirements Met (out of 38) 3

Project Strategy Meets All Federal Agency/ACC Requirements No

Certified: 40-49 points,  
Silver: 50-59 points,  
Gold: 60-79 points,  
Platinum: 80+ points

## Requirement Sources

MOU - Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding, incorporated as part of Executive Order 13423  
EPAct 2005 - Energy Policy Act of 2005  
EISA 2007 - Energy Independence and Security Act of 2007  
EO 13058 - Protecting Federal Employees and the Public from Exposure to Tobacco Smoke in the Federal Workplace

## Notes

- 1 - ACC requirements established in "Energy and Facility Management Policy" signed by COMACC December 31, 2007
- 2 - Solar hot water heater system should provide at least 30% of demand; conduct life cycle cost analysis.
- 3 - Place Holder Implementation Action - DOE has not completed rulemaking for means/measures in reduction in fossil fuel-generated energy consumption.
- 4 - Place Holder Implementation Action - DOE has not completed rulemaking for means/measures applicable to Data Centers.
- 5 - Perform whole building energy simulation and conduct energy performance calculations per equation in CFR Title 10 Part 433 then derive corresponding number of LEED Energy Efficiency EA1 credits
- 6 - The Air Force has established three broad tiers of commissioning activities tailored to the size and complexity of the building and its system components; AF Fundamental Commissioning, AF Enhanced Commissioning and AF Commissioning for HVAC&R Start-up and Turnover.
- 7 - Compliance with MOU and EPAct 2005 requirements assures compliance with this LEED prerequisite.
- 8 - Performance requirement(s) must be incorporated into all Projects even if quantities/costs do not meet threshold amounts for obtaining the LEED credit(s).
- 9 - The LEED® 2009 reference standard is ASHRAE 62.1-2007 while the MOU references the 2004 edition; design per the updated 2007 standard.
- 10 - The LEED® 2009 reference standard is the 2007 edition of SMACNA's IAQ Guidelines for Occupied Buildings Under Construction while the MOU references the 1995 edition; design per the updated 2007 standard.

Section:

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX QQ

### SECTION 01 91 00 COMMISSIONING and SECTION 07 25 00.00 06 BUILDING AIR BARRIER SYSTEM



Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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## SECTION 01 91 00

## COMMISSIONING

01/10

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED 2009)

## ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline (2005) Commissioning Guideline

## NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard (1999) Procedural Standards for Building Systems Commissioning

## SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Commissioning Manual (1994, 1st Ed) HVAC Systems Commissioning Manual

## 1.2 DEFINITIONS and Abbreviation's

## 1.2.1 Abbreviation's

The following are common abbreviations used in the Specifications and in the Commissioning Plan. Definitions are found in Section 1.6.

A/E Architect/Design Engineer(Gov't)	FIO For Information Only
CA Commissioning Authority/Specialist	FT Functional Performance Test
CC Controls Contractor	CG General Contractor (prime)
Cx Commissioning	MC Mechanical Contractor
Cx Plan Commissioning Plan document	PC Prefunctional checklist
EC Electrical Contractor	PM Project Manager(Gov't)
TAB Test and Balance Contractor	Subs Subcontractors to General

## 1.2.2 Definitions

- 'a. "Basis of design" is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of

the design intent may be included.

- b. "Commissioning (Cx)" is a comprehensive and systematic process to verify that the building systems perform as designed to meet Government requirements and the design intent.
- c. "Commissioning Plan" (Cx Plan) is an overall plan that provides the structure, schedule and coordination planning for the Cx process.
- d. "Data logging" records data such as flows, currents, status, and pressures over time using stand-alone data loggers separate from the control system.
- e. "Deferred functional tests" are performed after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed before substantial completion.
- f. A "deficiency" is a condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the Contract documents.
- g. The "design intent" represents the ideas, concepts, and criteria that are conveyed through the Contract documents.
- h. "Factory testing" tests equipment on-site or at the factory by factory personnel.
- i. A "functional performance test" (FT) tests the dynamic function and operation of equipment and systems under full operation using manual (direct observation) or monitoring methods. For example, the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint.
- j. "Indirect indicators" indicate a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed.
- k. A "manual test" uses hand-held direct reading instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the observation).
- l. "Nonconformance" means a piece of equipment or a system does not perform properly or comply with the design intent.
- m. An "overwritten value" is a sensor value in the building control system that is overridden to see the response of a system. For example, changing the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation. See also "simulated signal."
- n. "Phased commissioning" is completed in phases (by floors or buildings, for example) due to the size of the structures or other scheduling issues, in order to minimize the total construction time.
- o. A "prefunctional checklist" (PC) is a list of items to inspect and elementary component tests to conduct to verify proper installation of

equipment, provided by the Contractor with the assistance of the Commissioning Agent. PCs are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated). However, some PC items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). PCs augment and are combined with the manufacturer's startup checklist.

- p. "Sampling" functionally tests only a fraction of the total number of identical or near identical pieces of equipment.
- q. "Seasonal performance tests" are FTs that are deferred until the system(s) will experience conditions closer to their design conditions.
- r. "Simulated conditions" are created conditions for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).
- s. A "simulated signal" uses a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.
- t. "Startup" includes the initial starting or activating of dynamic equipment and executing PCs.
- u. "Test requirements" specify what modes, functions, and conditions shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the individual sections of the Contract documents.
- v. "Trending" uses the building control system for monitoring.
- w. The "warranty period" involves the entire project, including equipment components. Warranty begins at substantial completion and extends for at least one year, unless specifically noted otherwise in the Contract documents and accepted submittals.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; The following shall be submitted:

#### SD-02 Shop Drawings

Commissioning Plan; G

Commissioning Plan prepared in accordance with Commissioning Standard, no later than 28 days after the approval of the Commissioning Specialist.

#### SD-03 Product Data

Pre-Functional Performance Test Checklists; G

At least 28 days prior to the start of Pre-Functional

Performance Test Checks. Submit the schedule for the test checks at least 14 days prior to the start of Pre-Functional Performance Test Checks.

#### Functional Performance Tests; G

Test procedures at least 28 days prior to the start of Functional Performance Tests. The schedule for the tests at least 14 days prior to the start of Functional Performance Tests.

### SD-07 Certificates

#### Commissioning Firm; G

Certification of the proposed Commissioning Firm's qualifications by one of the following ACG, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. Include in the documentation the date that the Certification was initially granted and the date when the current Certification expires. Any lapses in Certification of the proposed Commissioning Firm or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Firm shall be described in detail.

#### Commissioning Authority; G

Certification of the proposed Commissioning Authority's qualifications by one of the following ACG, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date when the current Certification expires. Any lapses in Certification of the proposed Commissioning Specialist or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Authority shall be described in detail.

### SD-11 Closeout Submittals

#### Commissioning Report; G

No later than 14 days after completion of Functional Performance Tests.

## 1.4 QUALITY ASSURANCE

### 1.4.1 Commissioning Firm

Provide a Commissioning Firm that is either a member of ACG or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Firm for approval. Any firm that has been the subject of disciplinary action by the ACG, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties

related to the HVAC systems, including Commissioning. All work specified in this Section and in other related Sections to be performed by the Commissioning Firm shall be considered invalid if the Commissioning Firm loses its certification prior to Contract completion and must be performed by an approved successor. These Commissioning services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The Commissioning Firm shall be a subcontractor of the prime Contractor and shall be financially and corporately independent of all other subcontractors. The Commissioning Firm shall report to and be paid by the prime Contractor.

#### 1.4.2 Commissioning Authority

##### 1.4.2.1 General

The Commissioning Authority shall be an ACG Certified Commissioning Agent, a NEBB Qualified Commissioning Administrator, or a TABB Certified Commissioning Supervisor and shall be an employee of the approved Commissioning Firm. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Commissioning Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Specialist for approval. Any individual that has been the subject of disciplinary action by the ACG, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including Commissioning. All work specified in this Section and in other related Sections performed by the Commissioning Specialist shall be considered invalid if the Commissioning Specialist loses his certification prior to Contract completion and must be performed by the approved successor.

##### 1.4.2.2 Responsibilities

Perform all Commissioning work specified herein and in related sections under the direct guidance of the Commissioning Specialist. The Commissioning Specialist shall prepare the Commissioning Plan, which will be a comprehensive schedule and will include all submittal requirements for procedures, notifications, reports and the Commissioning Report. After approval of the Commissioning Plan, revise the schedule to reflect the schedule requirements in the Commissioning Plan.

#### 1.5 DESCRIPTION

The Cx process shall encompass and coordinate system documentation, equipment startup, control system calibration, testing and balancing, performance testing, and training. Cx shall begin in the design phase by documenting the design intent and continue through the construction phase and warranty period with actual verification of performance. Cx shall be completed before substantial completion. Cx does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

##### 1.5.1 Process

The following activities outline the Cx tasks specified in this section and the general order in which they occur. The Commissioning Agent (CA) shall coordinate all activities. The Quality Control System established under Section 01 45 01 USACE Quality Control Shall be maintained.

- a. Review design development and construction documents and document the basis of design and design intent.
- b. Conduct a scoping meeting to review the Cx process with the Cx team members.
- c. Develop a Cx Plan.
- d. Schedule additional meetings throughout construction with necessary parties attending, to plan, scope, coordinate, schedule future activities, and resolve problems.
- e. Collect equipment documentation during normal submittals, including detailed startup procedures.
- f. Review submittals.
- g. Develop startup plans, startup documentation formats, and PCs to be completed during the startup process.
- h. Perform startup and initial checkout.
- i. Develop and execute FT procedures.
- j. Correct items of nonconformance in materials, installation, or setup and retest the system.
- k. Submit a Deficiency Report and Resolution Record.
- l. Review documentation for completeness.
- m. Complete and submit the Final Cx Report.
- n. Review, pre-approve and coordinate Government personnel training and verify completion.
- o. Perform deferred testing as specified and required, including unforeseen deferred tests, seasonal testing, short-term diagnostic testing, and end-of-warranty review.

1.5.2 Written Work Products

The Cx process generates a number of written work products. The Cx Plan shall list all the formal written work products, describe briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location in the specification to create them. In summary, the written products are:

Product	Developed By	Approved by
Design and document review	CA	PM, A/E
Draft and Final Cx Plan	CA	PM, A/E
Meeting minutes	Contractor	
Cx schedules	Contractor, CA,	
Equipment documentation submittals	Contractor	CA
Sequence clarifications	Contractor	CA
PCs	Contractor with CA assistance	CA, A/E

Product	Developed By	Approved by
Startup and initial checkout plan	Contractor, CA compiles existing documents	CA
Completed startup, initial checkout, and PC forms	Contractor	CA, A/E
TAB Plan	Contractor	CA
Final TAB report	Contractor	CA
Issues log (deficiencies)	CA	PM, A/E
Cx Progress Record	CA	PM, A/E
Deficiency reports	CA	PM, A/E
FT forms	Contractor	CA, PM
Completed FT forms	Contractor	
O&M manual data	Contractor	
Cx record book	CA	
Training Plan	Contractor, CA	
Specific training agendas	Contractor	
Final Cx Report	CA	
Miscellaneous approvals	PM	

## 1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

SD-02 Shop Drawings

SD-11 Closeout Submittals G

Final Cx Report

## 1.7 SYSTEMS TO BE COMMISSIONED

The following equipment and systems shall be commissioned in accordance with the procedures described in this section.

- a. Division 23 systems (all mechanical HVAC Equipment including ductwork and piping, on passive and mechanical systems, and DDC Control)
- b. Division 7 Building Air Barrier
- c. Division 22 Plumbing systems and technologies (including water collection, treatment, and heating)
- d. Division 26 Daylighting systems (including lighting controls)

## 1.8 COORDINATION

### 1.8.1 Commissioning Team

The members of the Cx team shall consist of the CA, the CG, the PM, A/E, subcontractors, QC Specialists, Government representative(s) including operation and maintenance (O&M) staff. All members shall work together and with vendors to fulfill their contracted responsibilities and meet the



objectives of the Contract documents and Cx process. The CA shall regularly communicate with all members of the Cx team, keeping them apprised of Cx progress and scheduling changes through memos, progress reports, or other methods of communication.

#### 1.8.2 Cx Schedule

The CA shall work with the CG and the PM to schedule the Cx activities. The CA shall provide the initial schedule of primary events at the Cx scoping meeting. The Draft Cx Plan shall provide a format for this schedule, and both shall be submitted together. The CA shall provide sufficient notice to the CG and the PM for scheduling Cx activities. The Contractor shall integrate all Cx activities into the master schedule. As the construction progresses the CA shall update the Cx schedule with more details. Notify the PM and CA ahead of time when Cx activities not yet performed or not yet scheduled will impact the construction schedule.

#### 1.8.3 Meetings

##### 1.8.3.1 Scoping Meeting

The Cx scoping meeting shall be scheduled by the CA within 90 days of award of the construction Contract. The CA shall plan and conduct the Cx scoping meeting with the entire Cx team in attendance. Meeting minutes shall be distributed to all parties within one week. The agenda shall include a review of each building system to be commissioned, including its intended operation, Cx requirements, and completion and startup schedules. The scope of work, tasks, schedules, deliverables, and responsibilities for implementation of the Cx Plan shall be established. Information gathered from this meeting will allow the CA to update the Cx Plan, which shall also be distributed to all parties.

##### 1.8.3.2 Miscellaneous Meetings

Other meetings will be planned and conducted by the CA as construction progresses. These meetings will cover coordination, deficiency resolution, and planning issues. These meetings shall be held monthly, until the final three months of construction when they shall be held weekly. Cx shall also be discussed in all weekly progress meetings.

#### 1.9 RESPONSIBILITIES

The responsibilities of various parties in the Cx process are as specified. The PM, A/E and CA are not responsible for construction means, methods, job safety, or management function related to Cx on the job site.

##### 1.9.1 CA Responsibilities

The CA is responsible for writing and verification of compliance with the Cx Plan and the preparation of Cx checklists and reports. This shall involve coordinating and directing the Cx activities in a logical, sequential, and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules, and technical expertise. All submittals applicable to systems being commissioned shall be reviewed and evaluated by the CA for compliance with Cx needs and the Contract documents. The CA shall ensure proper

coordination and submission of all documents. During construction, the CA shall perform site visits as necessary to observe component and system installations; attend selected planning and job-site meetings to obtain information on construction progress; review construction meeting minutes for potential revisions or substitutions related to the Cx process; and assist in resolving any discrepancies.

#### 1.9.2 Contractor Responsibilities

During construction, the CG shall maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. These drawings shall be updated after completion of Cx (excluding deferred testing).

#### 1.10 COMMISSIONING PLAN

The CA shall develop a Draft Cx Plan to identify how Cx activities will be integrated into general construction and trade activities. Various templates are available on the [PECI website](#). The Plan shall identify how Cx responsibilities are distributed. The Specifications will take precedence over the Cx Plan in the event of conflicting requirements between the two. The Cx Plan shall include the following components:

- a. A brief overview of the Cx process, including goals, objectives, and general project information.
- b. A list of systems to be commissioned.
- c. Identification of Cx participants and responsibilities.
- d. A description of the management, communication, and reporting of the Cx Plan.
- e. An outline of the Cx process scope including:
  1. Documentation of basis of design and design intent.
  2. Startup and testing procedures, including sampling procedures.
  3. Observation procedures. Provide copy of applicable section of QC Plan. Highlight the requirements for verification of the correct installation of all systems.
  4. System performance verification.
  5. Submittal review procedures. Provide a copy of Section VI of the QC Plan.
  6. O&M documentation. Describe the information to be provided to the client as required by Contract under operation and maintenance data.
  7. Training activities. Provide a copy of Section within the QC Plan.
  8. Warranty period activities.

- f. A list and description of the written work products, as specified in the paragraph Written Work Products.
- g. An activity schedule.
- h. A description of the rigor, scope, and procedures of testing and acceptance. Provide a copy of [applicable section](#) of the QC Plan.

The Draft Cx Plan shall be submitted to the [PM](#) before the scoping meeting. Within 30 days after the initial Cx scoping meeting the CA shall update and submit the Draft Cx Plan for [PM and A/E](#) final review and approval. The CA shall adjust the Draft Cx Plan as required and submit as the [Final Cx Plan](#) prior to commencement of work. The Final Cx Plan shall include specific scheduling of required testing procedures for commissioned equipment and systems. A [Commissioning Agent Certification Letter](#) signed by the CA shall be submitted, certifying the Cx Plan has been successfully executed and the design intent of the facility has been achieved.

#### 1.11 CX TEAM TRAINING

The [CG](#) shall provide training according to a written [training plan](#) to Cx team members as determined by the CA prior to commencement of construction. The first training session shall describe the overall system design concept and the design concept of each equipment section. This presentation shall include a review of systems using the simplified system schematics (one-line drawings) including chilled water systems, condenser water or heat rejection systems, heating systems, fuel oil and gas supply systems, supply air systems, exhaust systems, and/or outside air strategies, as determined by the CA. For the primary HVAC equipment, the [CG](#) shall provide a short discussion of the control of the equipment during the mechanical or electrical training. One training session shall include a presentation discussing the use of the blank FT forms for recommissioning equipment.

#### 1.12 COMMISSIONED EQUIPMENT DATA

The CA shall request in writing from the [CG](#) specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Cx Plan, and shall review and evaluate this information for compliance with Cx needs, in accordance with this section and [specification](#) Section [addressing](#) SUBMITTAL PROCEDURES. This information shall include normal cut sheets; addenda; change orders; full details of any required testing; full factory testing reports, if any. In addition, the installation, startup, and checkout materials that are shipped inside the equipment and the actual field checkout forms to be used by the factory or field technicians shall be submitted to the CA. The CA may request further documentation as necessary for the Cx process. Any request for additional data shall be made prior to receipt of normal submittal data from equipment manufacturers. This information is to be used in the Cx process prior to the regular formal O&M manual submittals, and shall be compiled and maintained in a building systems book to be included in the O&M manuals.

#### 1.13 REPORTING

The CA shall provide Cx progress reports monthly to the [PM](#) and Cx team, with increasing frequency as construction and Cx progress. Sample standard forms shall be provided and referenced in the Cx Plan. Example standard

forms are available for reference in Appendix B and on the [PECI website](#). Testing or review approvals and nonconformance and deficiency reports shall be made regularly.

#### 1.13.1 Cx Report

The CA shall compile a Cx Report focusing on evaluating Cx process issues, and provide four copies to the PM within 30 days after occupancy. The report shall summarize all of the tasks, findings, conclusions, and recommendations of the Cx process. A list of participants and roles, brief building description, overview of Cx and testing scope, and general description of testing and verification methods shall be included. The CA shall provide the following for each piece of equipment:

- a. Assessment of how the equipment meets the specifications and design intent.
- b. Equipment installation verification.
- c. O&M documentation evaluation.
- d. Operator training evaluation.
- e. Assessment of the value of the Cx process.

Specifically list all outstanding nonconformance items. Each nonconformance issue shall be referenced to the specific item where the deficiency is documented. List any uncorrected compromises in the environmentally responsive features. List recommendations such as improvements to equipment or operations, future actions including testing justified by seasonal conditions, or Cx process changes. Include a brief description of the verification method used and observations and conclusions from the testing of each piece of equipment. All acquired Cx documentation, including completed FTs, logs, minutes, reports, deficiency lists, communications, findings, and unresolved issues, shall be compiled in appendices and provided with the Cx Report.

## PART 2 PRODUCTS

### 2.1 TEST EQUIPMENT

Equipment shall be maintained in good repair and operational condition throughout the duration of use on this project.

#### 2.1.1 Equipment Provisions

The CG shall provide all test equipment necessary to perform startup and initial checkout and required FT. Special equipment, tools and instruments available only from the vendor, specific to a piece of equipment, and required for testing equipment shall be turned over to the PM after testing has been completed.

#### 2.1.2 Equipment Calibration

All testing equipment shall be of sufficient quality and accuracy to test and measure system performance within the tolerances specified. Unless otherwise noted, the following minimum requirements apply. Temperature

sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.9 degrees F and a resolution of plus or minus 0.2 degrees F. Pressure sensors shall have an accuracy of plus or minus 2.0 percent of the value range being measured (not the full range of the meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available. Calibration documentation of all testing equipment shall be turned in with each testing episode. Serial numbers of equipment and standards used for QC, zeroing, and calibration shall be included.

## PART 3 EXECUTION

### 3.1 STARTUP AND PREFUNCTIONAL CHECKOUT

Each piece of equipment or system to be commissioned shall receive a full prefunctional checkout. No sampling strategies shall be used. Equipment shall not be temporarily started for Cx.

#### 3.1.1 Responsibilities

The CG has startup responsibility and shall complete systems and subsystems so they are fully functional and meeting the design objectives of the Contract documents. The Cx procedures and FT do not relieve or lessen this responsibility or shift that responsibility partially to the CA or the Government. Parties responsible for PC execution and startup shall be identified in the Cx scoping meeting and in the PCs.

#### 3.1.2 Startup and Checkout Plan

The CA shall assist the CG in developing PCs and detailed startup plans for all equipment. The primary role of the CA in this process is to witness and ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed.

##### 3.1.2.1 PCs

The PCs shall indicate required procedures to be executed as part of startup and prefunctional checkout of the systems. The CG shall determine which trade is responsible for executing and documenting each of the line item tasks and note that trade on the PC. Each task may have more than one trade responsible for its execution.

##### 3.1.2.2 Startup

The CG shall develop the full startup plan and submit the plan to the CA PM and A/E for review and approval. The CA PM and A/E shall review and evaluate the procedures and the procedure documentation format, noting any procedures that need to be revised or added. The plan shall contain a minimum of the following:

- a. PCs.
- b. The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a summary statement with a signature block added at the end.

c. The manufacturer's field checkout sheets.

#### 3.1.3 Execution of PCs and Startup

Four weeks prior to startup, the CG shall schedule startup and checkout activities with the Contracting Officer and CA. The performance of the PCs, startup, and checkout shall be directed and executed by the CG and witnessed by the CA. The CG shall provide skilled technicians to execute starting of equipment and shall ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem-solving. The CA and PM representative shall observe the procedures for each piece of equipment.

#### 3.1.4 Documentation

After startup completion, the CG shall provide the CA with a signed and dated copy of the completed startup and prefunctional tests and checklists. Only individuals that have direct knowledge and witnessed that a line item task on the PC was actually performed shall initial or check that item off. Witnessing supervisors shall not fill out these forms.

#### 3.1.5 Nonconformance and Approval in PCs and Startup

The CG shall clearly list any outstanding items of the startup and prefunctional procedures that were not completed successfully at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the PM and the CA within two days of test completion. The CA shall review the report and submit either a nonconformance report or an approval form to the PM. The CA shall work with the CG to correct and retest deficiencies or uncompleted items. The CA will involve the PM and others as necessary. The CG shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated startup report and a Statement of Correction on the original nonconformance report. When satisfactorily completed, the CA shall recommend approval of the execution of the PCs and startup of each system to the PM using a standard form.

#### 3.1.6 Phased Commissioning

The project may require startup and initial checkout to be executed in phases. This phasing shall be planned and scheduled in a coordination meeting of the CA, PM, and the CG. Results will be added to the master and Cx schedule.

### 3.2 SENSOR AND ACTUATOR CALIBRATION

All field-installed temperature, relative humidity, CO2 and pressure sensors and gages, and actuators (dampers and valves) on all equipment shall be calibrated. Test instruments shall have had a certified calibration within the last 12 months. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated. Procedures used shall be fully documented on the PCs or other suitable forms, along with written documentation of initial, intermediate and final results.

#### 3.2.1 Calibration Methods

Alternate methods may be used, if approved by the Government beforehand.

#### 3.2.1.1 All Sensors

The CG shall verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cables are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, verify they are reading within 0.4 degrees F of each other for temperature and within a tolerance of each other equal to two percent of the reading for pressure. Tolerances for critical applications may be tighter.

#### 3.2.1.2 Sensors Without Transmitters

Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage, or building automation system (BAS)) is within the tolerances listed in the table below in paragraph Tolerances, Standard Applications of the instrument-measured value. If not, install offset in BAS, calibrate, or replace sensor.

#### 3.2.1.3 Sensors With Transmitters

Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship, and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage, or BAS) is within the tolerances listed in the table below in paragraph Tolerances, Standard Applications of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.

#### 3.2.2 Tolerances, Standard Applications

Sensor	Required Tolerance (+/-)
Cooling coil, chilled and condenser water temps	0.7 F
Flow rates, water	4% of design
Relative humidity	4% of design
AHU wet bulb or dew point	3.6 F
Combustion flue temps	9.0 F
Hot water coil and boiler water temp	2.7 F
Oxygen or CO2 monitor	0.1% pts
Outside air, space air, duct air temps	0.7 F
CO monitor	0.01% pts
Watt-hour, voltage & amperage	1% of design
Natural gas and oil flow rate	1% of design
Pressures, air, water and gas	3% of design
Steam flow rate	3% of design
Flow rates, air	10% of design

Sensor	Required Tolerance
Barometric pressure	1.0 inch of Hg

### 3.2.3 Valve and Damper Stroke Setup and Check

#### 3.2.3.1 EMS Readout

For all damper actuator positions checked, verify the actual position against the BAS readout. Set pumps or fans to normal operating mode. Command damper closed, visually verify that damper is closed and adjust output zero signal as required. Command damper open, verify position is full open and adjust output signal as required. Command damper to three intermediate positions. If actual damper position doesn't reasonably correspond, replace actuator.

### 3.3 CONTROLS

Controls shall be tested and verified after startup and prefunctional checkout and after sensor and actuator calibration, as specified here and in Section [Specification Section 23](#). The CG shall be responsible for Cx activities related to controls. Before initial startup, the CG shall gather and review the current control sequences and interlocks and with the CA write detailed testing procedures.

#### 3.3.1 Control Drawings

Submit control drawings that include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications.

##### 3.3.1.1 Content

Drawings shall include:

- a. An overview narrative of the system (one or two paragraphs) generally describing system purpose, components, and function.
- b. All interactions and interlocks with other systems.
- c. Detailed delineation of control between any packaged controls and the BAS, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
- d. Written sequences of control for packaged controlled equipment.
- e. Startup sequences.
- f. Warm-up mode sequences.
- g. Normal operating mode sequences.
- h. Unoccupied mode sequences.
- i. Shutdown sequences.
- j. Capacity control sequences and equipment staging.



- k. Temperature and pressure control (e.g., setbacks, setups, resets).
- l. Detailed sequences for all control strategies (e.g., economizer control, optimum start/stop, staging, optimization, demand limiting).
- m. Effects of power or equipment failure with all standby component functions.
- n. Sequences for all alarms and emergency shut downs.
- o. Seasonal operational differences and recommendations.
- p. Initial and recommended values for all adjustable settings, setpoints, and parameters that are typically set or adjusted by operating staff. Include any other control settings, fixed values, or delays that will be useful during testing and operating the equipment.
- q. Schedules, if known.

#### 3.3.1.2 Format

To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered. The control drawings shall have a key to all abbreviations, and shall contain graphic schematic depictions of the systems and each component. The schematics shall include the system and component layout of any equipment that the building control system monitors, enables, or controls, including equipment primarily controlled by packaged or integral controls. Provide a full points list with the following included as a minimum for each point:

- a. Controlled system
- b. Point abbreviation
- c. Point description (e.g., DB temp, airflow)
- d. Display unit
- e. Control point or setpoint (Yes / No) (Point that controls equipment and can have its setpoint changed)
- f. Monitoring point (Yes / No) (Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification)
- g. Intermediate point (Yes / No) (Point whose value is used to make a calculation which then controls equipment; e.g., space temperatures that are averaged to a virtual point to control reset)
- h. Calculated point (Yes / No) ("Virtual" point generated from calculations of other point values)

The CG keep the PM, A/E and the CA informed of all changes to this list during programming and setup. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls

O&M manual submittal, as specified in Division 01 of Specifications.

### 3.3.2 Controls Initial Checkout

Indicate what tests on what systems should be completed prior to TAB using the building control system for TAB work. Coordinate with the CA, PM and TAB contractor for this determination. Provide a signed and dated certification to the CA and PM upon completion of the checkout of each controlled device, equipment, and system prior to FT for each piece of equipment or system, that all system programming is complete with reference to all aspects of the Contract documents, except FT requirements. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control, and virtual points as specified. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water, and building pressure). The CG shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout, and adjust the building control system prior to FT. At a minimum, the plan shall include for each type of equipment controlled by automatic controls:

- a. System name.
- b. List of devices.
- c. Step-by-step procedures for testing each controller after installation, including:
  1. Process of verifying proper hardware and wiring installation.
  2. Process of downloading programs to local controllers and verifying that they are addressed correctly.
  3. Process of performing operational checks of each controlled component.
  4. Plan and process for calibrating valve and damper actuators and all sensors.
  5. A description of the expected field adjustments for transmitters, controllers, and control actuators should control responses fall outside of expected values.
- d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has "passed" and is operating within the contract parameters.
- e. A description of the instrumentation required for testing.

### 3.3.3 Controls FT

The CA shall assist the CG in executing controls testing. Using a skilled technician who is familiar with this building, execute the FT of the controls system as specified for the controls contractor in Section Section 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS.

Execute all control system trend logs specified in Section 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS Section 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS. The building control system shall be sufficiently tested and approved by the CA and the PM before it is used for TAB or to verify performance of other components or systems.

### 3.4 TAB

TAB shall be completed after controls are tested, checked out, and adjusted. The CG shall be responsible for TAB preparation and activities, as specified here and in Section 23 05 93.00 10 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

#### 3.4.1 TAB Plan

Six weeks prior to starting TAB, submit an outline of the TAB plan and approach for each system and component to the CA, PM, and the controls contractor. This plan shall be developed after the TAB contractor has some familiarity with the building control system, and shall be reviewed by the CA. The TAB contractor shall review the TAB plan to determine the capabilities of the building control system toward completing TAB. The submitted plan shall include:

- a. Certification that the TAB contractor has reviewed the construction documents and the systems with the CG to sufficiently understand the design intent for each system.
- b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
- c. Field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted, and balanced with the data cells to be gathered for each.
- d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
- e. Final test report forms to be used.
- f. Detailed step-by-step procedures for TAB work for each system and issue (e.g., terminal flow calibration for each terminal type, diffuser proportioning, branch / submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions). Criteria for using air flow straighteners or relocating flow stations and sensors shall be discussed. Provide the analogous explanations for the water side.
- g. List of all air flow, water flow, sound level, system capacity, and efficiency measurements to be performed and a description of specific test procedures, parameters, and formulas to be used.
- h. Details of how total flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pilot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic.).

- i. Identification and types of measurement instruments to be used and their most recent calibration date.
- j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.
- k. Confirmation that the TAB contractor understands the outside air ventilation criteria under all conditions.
- l. Details of whether and how minimum outside air infiltration will be verified and set, and for what level (e.g., total building, zone).
- m. Details of how building static and exhaust fan/relief damper capacity will be checked.
- n. Proposed selection points for sound measurements and sound measurement methods.
- o. Details of methods for making any specified coil or other system plant capacity measurements.
- p. Details of any TAB work to be done in phases (e.g., by floor, by building).
- q. Details regarding specified deferred or seasonal TAB work.
- r. Details of any specified false loading of systems to complete TAB work.
- s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.
- t. Details of any required interstitial cavity differential pressure measurements and calculations.
- u. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests (scope and frequency).
- v. Plan for formal progress reports (scope and frequency).
- w. Plan for formal deficiency reports (scope, frequency, and distribution).

#### 3.4.2 Scheduling

Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing, cleaning, equipment startup, and TAB start and completion for use by the CA. Update the schedule as appropriate, and notify the PM and CA prior to the start of each activity.

#### 3.4.3 Preparation

Meet with the TAB contractor prior to beginning TAB. Provide the TAB contractor any needed unique instruments for setting terminal unit boxes and instructions for their use; for instance, handheld control system

interface for use around the building during TAB. For a given system, have required PCs, calibrations, startup, and selected FTs completed and approved by the CA prior to TAB. Install a P/T plug at each water sensor that is an input point to the control system. List and clearly identify on the as-built drawings the locations of all air-flow stations. Provide test holes in ducts and plenums where directed by the TAB contractor to allow air measurements and air balancing, providing an approved plug. Provide temperature and pressure taps according to the Contract documents for TAB and Cx testing. Provide sufficient FT of the HVAC control system and evaluate its use for TAB before TAB is executed. Put all HVAC equipment and systems into operation and continue the operation during each working day of TAB and Cx, as required.

#### 3.4.4 TAB Execution

Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for the TAB contractor to operate the system without assistance. The CA shall witness the HVAC piping test and flushing procedures and the ductwork testing and cleaning procedures, sufficiently to be confident that proper procedures are followed. Testing results shall be documented and copies provided to include in the O&M manuals. Notify the PM of any deficiencies in results or procedures. The CA shall evaluate air and water systems balancing by initiating spot testing, by reviewing completed reports, and by selected site observation. Air and water TAB shall be completed with discrepancies and problems remedied before FT of the respective air- or water-related systems.

#### 3.4.5 TAB Reports

A running log of events and issues shall be kept by the TAB contractor. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests to the CA and PM a minimum of twice a week. Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the building control system setup and operation. Provide a draft TAB report to the CA within two weeks of TAB completion. The report shall contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. Provide the CA and PM with any requested data gathered but not shown on the draft reports. Provide a final TAB report with details for CA review and PM and A/E approval.

### 3.5 FUNCTIONAL PERFORMANCE TESTING

The CA shall direct, witness, and document the FT of all equipment and systems. The CG shall execute the tests with skilled technicians provided under the direction of the CA. Systems shall be tested under all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, full range of part- and full-load) and under abnormal modes and conditions (power failure, interlocks with other equipment, alarms, no flow, equipment failure). The CG shall verify that systems are run through all the building control system's sequences of operation, and components shall be verified to be responding as the sequences state. The CA shall assist the CG to develop the FT procedures in a sequential written form, and coordinate, oversee, and document the actual testing.

### 3.5.1 Development of Test Procedures

Before test procedures are written, the CG shall obtain all requested documentation regarding equipment sequence of operation and testing procedures, including procedures for equipment installed by factory representatives and a current list of change orders affecting equipment or systems. The change orders shall include an updated points list, program code, control sequences, and parameters. Using the testing parameters and requirements found in the technical sections *manufacturer's recommendations* of commissioned equipment and systems the CG shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. The CG shall assist the CA in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings, or equipment documentation is not sufficient for writing detailed testing procedures. Prior to execution, the CG shall provide a copy of the test procedures to the CA who shall review the tests for feasibility, safety, equipment operation, sequences, and warranty protection. The test procedure forms shall include the following, at a minimum:

- a. System and equipment or component name(s) and configuration(s).
- b. Equipment location and ID number.
- c. Unique test ID number, and reference to unique PC and startup documentation ID numbers.
- d. Date.
- e. Project name.
- f. Participating parties.
- g. A copy of the section describing the test requirements.
- h. A copy of the specific sequence of operations or other specified parameters being verified.
- i. Formulas used in any calculations.
- j. Required pre-test field measurements.
- k. Instructions for setting up the test, including special cautions, alarm limits, or other equipment-specific information.
- l. Specific step-by-step procedures to execute the test in a clear, sequential, and repeatable format.
- m. Acceptance criteria of proper performance with a Yes / No check box to allow for clear marking of whether or not proper performance of each part of the test was achieved.
- n. A section for comments.
- o. Signature and date blocks for the CA, Contractor, PM and A/E.

### 3.5.2 Test Methods

#### 3.5.2.1 Functional Performance

FT and verification shall be achieved by manual testing or by monitoring the performance and analyzing the results using the energy management control system's trend log capabilities or by stand-alone data loggers. A combination of methods may be required to test the complete sequence of operations. The A/E and CA shall determine which method, or combination of methods, is most appropriate for tests that do not have a method specified. The CG shall provide FT of commissioned equipment and systems. CA and A/E shall analyze any functional performance trend logs and monitoring data to verify performance, and witness and evaluate manual FTs performed by the CG. The CG shall assist the CA in interpreting the monitoring data, as necessary.

#### 3.5.2.2 Simulated Conditions

Simulating conditions (not by an overwritten value) shall be allowed only when timing the testing to experience actual conditions is not practical. Sensors, transducers, and devices shall have been calibrated before simulating conditions.

#### 3.5.2.3 Overwritten Values

Overwriting sensor values to simulate a condition shall be allowed only when simulating conditions in other ways is not practical, and shall be used with caution. Sensors, transducers and devices shall have been calibrated before overwriting values.

#### 3.5.2.4 Altering Setpoints

Altering setpoints to test a sequence is an acceptable alternative to overwriting sensor values when simulating conditions in other ways is not practical.

#### 3.5.2.5 Indirect Indicators

Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the building control system represent actual conditions and responses. Much of this verification shall be completed during prefunctional testing.

#### 3.5.2.6 Setup

Each function and test shall be performed under conditions that simulate actual conditions as close as possible. The CG shall provide materials, system modifications, and other necessities to produce the flows, pressures, temperatures, or other values necessary to execute the test according to the specified conditions. Where equipment requires integral safety devices to stop or prevent equipment operation unless minimum safety standards or conditions are met, FT procedures shall demonstrate the actual performance of safety shutoffs in real or closely-simulated conditions of failure. At completion of the test, the CG shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test conditions.

#### 3.5.3 Coordination and Scheduling

FT shall be performed after PCs, startup, calibration, and TAB are complete for a given system. The CA shall schedule FTs through the CG and PM. Testing shall proceed from components to subsystems to systems; when the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems shall be checked.

#### 3.5.4 Documentation

The CA shall document the results of all FTs using the specific test procedure forms developed by the CA for that purpose. The CG shall submit copies of the completed forms with the O&M manual data and as part of the Cx Report.

#### 3.6 NONCONFORMANCE

Every effort shall be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. Nonconformance and deficiencies observed in materials, installation, or operation shall be addressed immediately, in terms of notification to responsible parties, and providing recommended actions to correct deficiencies. The CG shall have responsibility for resolving construction deficiencies, and the CA shall assist with problem solving as necessary. If a design revision is deemed necessary and approved by the PM, the designer shall have responsibility for providing design revision. The CA shall maintain a master deficiency and resolution log, and shall provide the PM with written progress reports and test results with recommended actions.

##### 3.6.1 Procedure

All deficiencies or nonconformance issues shall be noted and reported to the PM on a standard nonconformance form. The CG shall report in writing to the CA and PM weekly, or at a minimum as often as Cx meetings are being scheduled, concerning the status of each apparent outstanding discrepancy identified during Cx. The report shall include explanations of any disagreements and proposals for their resolution, and a copy shall be included in the deficiency report and resolution record. Corrections of minor deficiencies may be made during the tests at the discretion of the CA, and the deficiency and resolution shall be documented on the test procedure form.

##### 3.6.1.1 Non-Disputed Deficiencies

When a deficiency is identified, the CA shall discuss the issue with the CG. When there is no dispute on the deficiency and the CG accepts responsibility to correct it, the CA shall document the deficiency, the adjustments or alterations required to correct it, and the CG's response and intentions. The next test or sequence may then be performed. After the day's work, the CA shall submit all the nonconformance reports to the PM for signature. Copies shall be provided to the CG and PM. The CG shall correct the deficiency, sign the statement of correction at the bottom of the nonconformance form certifying that the equipment is ready to be retested and shall send it back to the CA. The CA shall reschedule the test and the test shall be repeated as specified in the paragraph Retesting.

##### 3.6.1.2 Disputed Deficiencies

If there is a dispute about a deficiency, regarding whether it is a



deficiency or who is responsible, the deficiency shall be documented on the nonconformance form with the CG's response and a copy given to the PM and CG. Resolutions shall be made at the lowest management level possible. Additional parties shall be brought into the discussions as needed. Final interpretive and acceptance authority is with the PM. The CA shall document the resolution process. Once the interpretation and resolution have been decided, the CG shall correct the deficiency, sign the statement of correction on the nonconformance form and provide it to the CA. The CA shall reschedule the test and the test shall be repeated as specified in the paragraph Retesting.

### 3.6.2 Retesting

The cost to retest a prefunctional test or FT shall be solely the responsibility of the CG. Any required retesting by the CG shall not be considered a justified reason for a claim of delay or for a time extension by the CG. The CA and PM representative shall witness retesting as necessary until satisfactory performance is achieved.

### 3.6.3 Failure Due to Manufacturer Defect

If the greater of 10 percent of, or three, identical pieces of equipment (size alone does not constitute a difference) fail to perform to the Contract documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the PM. In such case, the CG shall provide the PM with the following:

- a. Within one week of notification from the PM, the CG or manufacturer's representative shall examine all other identical units making a record of the findings.
- b. Within two weeks of the original notification, the CG or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation. The PM shall determine whether a replacement of all identical units or a repair is acceptable.
- c. Two examples of the proposed solution shall be installed by the CG and the PM shall be allowed to test the installations for up to one week, upon which the PM will decide whether to accept the solution.
- d. Upon acceptance, the CG and manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

### 3.6.4 Deficiency Report and Resolution Record

The CA shall submit original nonconformance forms with the deficiency report and resolution record at the end of the project. The deficiency report and resolution record shall contain documented items of nonconformance in materials, installation, or operation, including the master deficiency and resolution log, and documented results from startup, PCs, FT, and short-term diagnostic monitoring, as specified. Details of

the components or systems found to be noncompliant with the drawings and specifications shall be included. Adjustments and alterations performed or required to correct the deficiencies and the responsible parties shall be identified.

### 3.7 DEFERRED TESTING

#### 3.7.1 Unforeseen Deferred Tests

If any check or test cannot be completed due to the building structure, required occupancy condition, or other deficiency, a request for delay execution of checklists and FT may be delayed contingent on approval of the PM. These tests shall be conducted as soon as possible in the same manner as seasonal testing.

#### 3.7.2 Seasonal Testing

The CA shall schedule, coordinate, and observe additional testing for seasonal variation in operations and control strategies during the opposite season to verify performance of the HVAC system and controls. The CG shall execute and document tests and correct deficiencies with facilities staff and the CA and PM witnessing. Testing shall be completed during the warranty period to fully test all sequences of operation. The CG shall make necessary revisions to O&M manuals and records due to the testing.

#### 3.7.3 Short-Term Diagnostic Testing

After initial occupancy, the CG shall perform short-term diagnostic testing, using data acquisition equipment or the building automation system to record system operation over a two- to three-week period. The dynamic interactions between components in the building system shall be investigated. The scheduling, interaction between heating and cooling, and effectiveness of the HVAC system in meeting the comfort requirements a design conditions shall be evaluated. The CG shall document tests and findings, and correct deficiencies according to the original testing requirements.

### 3.8 REVIEW AND APPROVAL

The CA shall validate that the testing requirements of this Contract are accomplished, and shall note each satisfactorily demonstrated function on the test form. Formal approval of the FT shall be made after review by the A/E, CA and PM. The CA shall evaluate each test and report to the PM and A/E using a standard form. The PM and A/E shall give final approval on each test using the same form, and provide signed copies to the CA and the CG.

-- End of Section --

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## SECTION 07 25 00.00 06

BUILDING AIR BARRIER SYSTEM  
01/10

## PART 1 GENERAL

## 1.1 CONTRACTOR RESPONSIBILITY

The Contractor is responsible for the construction of an air barrier system that is contiguous and connected across the six surfaces of the building envelope meeting the performance requirements as outlined in this specification.

The Contractor shall perform a building air tightness test and thermography test to demonstrate that the building envelope is properly sealed and insulated. The testing shall be performed in accordance with the procedures outlined in this specification.

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM C 779	(2003) Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
ASTM C 1060	(90; R 2003) Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings
ASTM E 1186	(2003) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
ASTM E 1827	(96; R 2002) Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
ASTM D 4541	(2002) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

## INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 6781	(1983) Thermal Insulation - Qualitative Detection of Thermal Irregularities in Building Envelopes - Infrared Method, First Edition
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### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

#### SD-03 Product Data

##### Air Barrier Inspector

The inspector shall have 2 years experience in the installation of air barrier materials and assemblies including the experience in joining and sealing various components, and sealing of penetrations of air barriers. The inspector shall have experience coordinating and instructing subcontractors involved in the installation joining and sealing of air barrier materials and components.

##### Building Air Tightness Test Technician

The testing technician shall have 2 years experience in air tightness testing using the specified testing standard.

##### Building Air Tightness Test Procedures; G, DO

The contractor shall submit detailed test procedures indicating the test apparatus, the test methods and procedures, and the analysis methods to be employed for the Building Air Tightness Test. The Building Air Tightness Test Procedures shall be submitted not later than 60 days after Notice to Proceed.

The contractor shall submit detailed test procedures indicating the test apparatus, the test methods and procedures, and the analysis methods to be employed for the Thermography Test. The Thermography Test Procedures shall be submitted not later than 60 days after Notice to Proceed.

##### Thermographer

The Thermographer shall have a Certification in Infrared Building Science from the Infrared Training Center or from the Building Science Institute. The thermographer shall have 2 years experience in infrared thermography.

#### SD-06 Test Reports

##### Test Reports; G, RO

The inspection and testing agency will submit a certified written report, in duplicate, of each inspection, test, or similar service to the Contractor with duplicate copies to the Contracting Officer not later than 10 days after each test.

Report Data: Written reports of each inspection and test or

similar service shall include all the Report items described in ASTM E 1827. Additionally, the report shall also include the following information:

- a. Date of Issue
- b. Project title and number
- c. Name, address, and telephone number of testing agency
- d. Dates and locations of samples and tests or inspections
- e. Names of individuals making the inspection or test
- f. Designation of the Work and test method
- g. Identification of product and Specification Section
- h. Complete inspection or test data
- i. Test results and an interpretation of test results
- j. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements
- k. Name and signature of laboratory inspector
- l. Recommendations on retesting

#### Building Air Tightness Test Reports; G, DO

The Building Air Tightness Test analysis, and report shall be submitted not later than 10 days after the test.

#### Thermography Test Report; G, DO

The Thermography Test analysis, and report shall be submitted not later than 10 days after the test.

### 1.4 ADMINISTRATIVE AND PROCEDURAL REQUIREMENTS

This section includes administrative and procedural requirements for accomplishing an airtight building enclosure that controls infiltration or exfiltration of air.

1. The airtight components of the building enclosure and the joints, junctures and transitions between materials, products, and assemblies forming the airtightness of the building enclosure are called "the air barrier system".

2. The Contractor is responsible for the coordination between the trades, the proper scheduling and sequencing of the work, preconstruction meetings, inspections, tests, and related actions including inspection and test reports.

3. The Contractor shall ensure that the intent of constructing the building enclosure with a continuous air barrier system to control air leakage into or out of the conditioned space is achieved. The air barrier system shall have the following characteristics:

- a. It must be continuous with all joints sealed.
- b. It must be structurally supported to withstand positive and negative air pressures applied to the building enclosure.
- c. Connection shall be made between:
  - 1) Foundation and walls
  - 2) Walls and windows
  - 3) Walls and doors
  - 4) Different wall systems

- 5) Walls and roof
- 6) Walls and roof over unconditioned space
- 7) Walls, floors, and roofs across construction, control, and expansion joints.
- 8) Walls, floors, and roofs to utility, pipe and duct penetrations.

4. It is the Contractor's responsibility to ensure that all penetrations through the air barrier system, and all paths of air infiltration or exfiltration, are sealed airtight.

5. Inspection and testing services are required to verify compliance with requirements specified or indicated.

#### 1.5 BUILDING AIR TIGHTNESS TEST TECHNICIAN RESPONSIBILITIES

The technician shall:

- a. Describe the test procedures, test apparatus, and analysis method.
- b. Perform the Building Air Tightness Test.
- c. Perform the Thermography Test.
- d. Participate in identifying deficiencies in the building construction upon failure of a test to meet the specified leakage rate.
- e. Submit a report of each air tightness test whether successful or not.
- e. Submit a report of each thermography test identifying problem areas.

#### 1.6 QUALITY CONTROL

The Contractor shall engage the services of an experienced air barrier inspector to oversee the sequencing and installation of the air barrier component materials and assemblies, to oversee the proper joining and sealing of the materials and assemblies, to oversee the sealing of penetrations of the air barrier materials and assemblies, and to instruct the subcontractors on the above.

##### 1.6.1 Documentation and Reporting

Installers shall document the entire installation process on daily job site reports. These reports include information on the Installer, substrates, substrate preparation, products used, ambient and substrate temperature, the location of the air barrier installation, the results of the quality control procedures, and testing results.

#### 1.7 CONTRACTOR RESPONSIBILITIES

##### 1.7.1 Coordination of Sub-Contractor(s)

The Contractor shall provide coordination between the Sub-Contractors involved in the construction of the air barrier system, coordinate the sequence of construction to ensure continuity of the air barrier system joints, junctures, penetrations, and transitions between materials and assemblies of materials and products from substructure to walls to roof.

The Contractor shall provide quality assurance procedures, testing and verification as specified. The Contractor shall facilitate inspections, tests, and other quality control services specified elsewhere in the Contract Documents and required by the Contracting Officer.

#### 1.7.2 Pre-Construction Conferences

The Contractor shall organize pre-construction conferences between the sub-contractors involved in the construction of or penetration of the air barrier system and the air barrier inspector to discuss where each sub-contractor begins and ends, the sequence of installation, and each sub-contractor's responsibility to ensure airtight joints, junctures, penetrations and transitions between materials, products, and assemblies of products specified in the different sections to be installed by the different sub-contractors.

#### 1.7.3 Construction Mock-Up

The Contractor shall build a construction mock-up of every joint, juncture, and transition between materials, products, and assemblies of products specified in the different sections to be installed. Work will not begin until the mock-up is satisfactory to the Contracting Officer.

### 1.8 AIR BARRIER SYSTEM PERFORMANCE REQUIREMENTS

The air leakage of the entire building shall meet the air requirements as specified in paragraph BUILDING AIR TIGHTNESS TEST.

#### PART 2 PRODUCTS (NOT APPLICABLE)

#### PART 3 EXECUTION

##### 3.1 REPAIR AND PROTECTION

Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or sample taking and similar services. Upon completion of inspection, testing, or sample taking and similar services, the Contractor shall repair damaged construction and restore substrates and finishes, protect construction exposed by or for quality control service activities, and protect repaired construction.

##### 3.2 TESTING AND INSPECTION

The following qualitative and quantitative tests and inspections shall be conducted by the Contractor in the presence of the Contracting Officer during installation of the air barrier system.

###### 1. Qualitative Testing and Inspection:

- a. Provide a Daily Report of Observations with a copy to the Contracting Officer.
- b. Ensure continuity of the air barrier system throughout the building enclosure and that all gaps are covered, the covering is structurally sound, and all penetrations are sealed allowing for no infiltration or exfiltration through the air barrier system.



- c. Ensure structural support of the air barrier system to withstand design air pressures.
- d. Ensure masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions and mortar droppings, with mortar joints struck flush or as required by the manufacturer of the air barrier material.
- e. Ensure site conditions for application temperature, and dryness of substrates are within guidelines.
- f. Ensure substrate surfaces are properly primed.
- g. Ensure laps in materials are at least a 2-inch minimum, shingled in the correct direction or mastic applied on exposed edges with no fishmouths.
- h. Ensure that mastic is applied on cut edges.
- i. Ensure that a roller has been used to enhance adhesion.
- j. Measure application thickness of liquid applied materials to manufacturer's specifications for the specific substrate.
- k. Ensure that the correct materials are installed for compatibility.
- l. Ensure proper transitions for change in direction and structural support at gaps.
- m. Ensure proper connection between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.

## 2. Quantitative Tests:

- a. Provide written test reports of all tests performed with a copy to the Contracting Officer.
- b. Determine the bond strength of coatings to substrate in accordance with [ASTM D 4541](#).

### 3.3 BUILDING AIR TIGHTNESS TEST

A building air test shall follow the guidance in the U.S. Army Corps of Engineers Air Leakage Test Protocol for Measuring Air Leakage in Buildings. This protocol is available on the Whole Building Design Guide website- [http://www.wbdg.org/references/pa\\_dod\\_energy.php](http://www.wbdg.org/references/pa_dod_energy.php). The fan pressurization test to determine final compliance with the airtightness requirement shall be conducted when all components of the air barrier system have been installed and inspected, and have passed any intermediate testing procedures as detailed in the construction drawings and specifications. The test may be conducted before finishes that are not part of the air barrier system have been installed. For example, if suspended ceiling tile, interior gypsum board, or cladding systems are not part of the air barrier system, the test may be conducted before they are installed.

### 3.3.1 Test Requirements

The air leakage test must be performed in accordance with ASTM E 779 with the following additions and exceptions:

The test consists of measuring the flow rates required to establish a minimum of 12 positive and 12 negative building pressures. The lowest test pressure shall be 25 Pa; the highest test pressure shall be 75 Pa; and there must be at least 25 Pa difference between the lowest and highest test pressures.

The test pressure must be measured in a representative location such that pressures in the extremities of the enclosure can be shown to not exceed 10% of the measured test pressure. At least 12 bias pressure readings must be taken across the envelope and averaged over at least 20 seconds each before and after the flow rate measurements. None of the bias pressure readings must exceed 30 percent of the minimum test pressure when testing in both directions.

Where it can be shown that it is impossible to test in both directions, then the building may be tested in the positive direction only, provided the bias pressure does not exceed 10% of the minimum test pressure.

The mean value of the air leakage flow rate calculated from measured data at 0.3 in wg (75 Pa) must not exceed 0.25 cu ft/ minute per square foot of envelope area (0.25 CFM75/ft<sup>2</sup>) and the upper confidence limit as defined by ASTM E-779 must not exceed (0.27 CFM75/ft<sup>2</sup>) or the upper confidence limit must not exceed (0.25 CFM75/ft<sup>2</sup>). Measurements must be referenced at standard conditions of 14.696 psi (101.325 KPa) and 68F (20C). The envelope area is to be supplied and/or confirmed by the Designer of Record (DOR).

The test shall be conducted with ventilation fans and exhaust fans turned off and the outdoor air inlets and exhaust outlets sealed (by dampers or masking). The contractor must provide a responsible HVAC technician with the authority to place the HVAC system in the correct mode for the pressure test. The test technician must have unhindered access to mechanical rooms, air handlers, exhaust fans, and outdoor air and exhaust dampers.

The contractor must ensure that all windows in the enclosure are kept closed. Entry and exit through doors in the test enclosure must be prohibited during the test. Data collected while the pressures and flows are affected by a door opening and closing shall be discarded.

The testing agency is required to perform a diagnostic evaluation in accordance with ASTM E 1186, whether the building achieves the air tightness requirement or not. The diagnostic evaluation will assist the contractor and responsible parties in identifying and eliminating air leakage so the building meets the requirement upon retesting. The testing results will also be expressed in terms of the Equivalent Leakage Area (EqLA) at 75 Pa. The EqLA is a the equivalent area of a flat plate that leaks the same amount as the building envelope at 75 Pa.

### 3.4 THERMOGRAPHY TEST

The building envelope shall be tested using Infrared Thermography technology. The thermography testing shall be completed in accordance with the requirements of [ASTM C 1060](#) and [ISO 6781](#). The Contracting Officer shall witness the testing. Testing shall occur just before the building

air tightness test. Testing shall also occur during the air tightness test so that areas of building air leaks are detected. If the building air tightness test is failed, Thermographic testing shall be repeated just before and during subsequent air tightness tests until the air tightness test is successful. The contractor shall provide a report. The report shall include thermographs in color and a color temperature scale to define the temperature indicated by the various colors. The report shall identify the high temperature reading, the outdoor air temperature, the building indoor air temperature, and the wind speed and direction. The report shall note any areas of compromise in the building envelope, and shall note all actions required and taken to correct those areas. Final thermography test report shall demonstrate the problem areas have been corrected. The complete test and analysis will be submitted to the Government for review and approval.

--End of Section--

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## APPENDIX RR

### Air Leakage Test Protocol

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**US Army Corps  
of Engineers®**  
Engineer Research and  
Development Center

# **U.S. Army Corps of Engineers Air Leakage Test Protocol for Measuring Air Leakage in Buildings**





**U.S. Army Corps of Engineers  
Air Leakage Test Protocol for  
Measuring Air Leakage in Buildings**

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## 1 Introduction

The 2005 Energy Policy Act requires that Federal facilities be built to achieve at least 30 percent energy savings over the 2004 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 90.1-2004. The U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) of the U.S. Army Corps of Engineers (USACE), in collaboration with Headquarters, USACE and centers of standardization for respective building types, the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL), and the ad hoc ASHRAE Military Technology Group has developed design guides to help U.S. Department of Defense (DOD) facilities achieve at least 30 percent energy savings over a baseline built to the minimum requirements of the ASHRAE Standard 90.1-2004 for new buildings to be constructed under the Military Transformation Program.

The design guides were completed in 2007 and 2008, and pertain to building types that include barracks ("Unaccompanied Enlisted Personnel Housing," or UEPH), trainee barracks, administrative buildings (e.g., a battalion headquarters, a company operation facility), a maintenance facility, a dining facility, a child development center, and an Army reserve center.

Among the major factors contributing to mold prevention and reduced energy use in all climate zones is air leakage through the building envelope. Over the past several years, ERDC-CERL has conducted building envelope leakage tests on existing facilities to gain a better understanding of the general leakiness of Army buildings, and to analyze the effect of increased air tightness on building energy consumption, and to develop air tightness criteria and performance requirements to include in design/construction strategies.

Based on the results of these studies USACE set a requirement that all new buildings and buildings undergoing major renovation shall pass an air leakage test, the results of which must be less than or equal to 0.25 CFM/sq ft of exterior envelope at 0.3 in. of water gage (75 Pa) pressure difference. The test is to be performed as outlined in the protocol developed by ERDC-CERL together with industrial partners. Depending on the climate, the total building energy cost savings due to improved building air tightness can range from 5 to 25 percent.

Since introduction of the requirements to air barrier and a maximum allowable air leakage rate, several Army buildings were constructed and tested for air tightness. Some of them were proven to have an air leakage rate between 0.16 and 0.25 CFM/sq ft at a pressure difference of 0.3 inches of water gage (75Pa). Few buildings have to be sealed and re-tested to meet these requirements. This experience has shown that, when buildings are designed and constructed with attention to details, they can meet U.S. Army requirements for air tightness with only a minimal cost increase (due primarily for development of architectural details and testing).

## 2 USACE Requirements For Building Air Tightness

The following sections outline USACE requirements for building air tightness and building air leakage testing for new Army construction:

### 2.1 Building Air Tightness Requirement

Design and construct the building envelopes of office buildings, office portions of mixed office and open space (e.g., company operations facilities), dining, barracks and instructional/training facilities with a continuous air barrier to control air leakage into (or out of) the conditioned space. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components. Clearly identify the boundary limits of the building air barriers, and of the zone or zones to be tested for building air tightness on the drawings.

Trace a continuous plane of air tightness throughout the building envelope and make flexible and seal all moving joints. The air barrier material(s) must have an air permeance not to exceed 0.004 CFM/sq ft at 0.3 in. wg [0.02 L/s.m<sup>2</sup> @ 75 Pa] when tested in accordance with American Society for Testing and Materials (ASTM) E 2178. Join and seal the air barrier material of each assembly in a flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of these assemblies and components.

Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement, or damage, and transfer the load to the structure. Seal all penetrations of the air barrier. If any unavoidable penetrations of the air barrier by electrical boxes or conduit, plumbing, and other assemblies are not air tight, make them air tight by sealing the assembly and the interface between the assembly and the air barrier or by extending the air barrier over the assembly. The air barrier must be durable to last the anticipated service life of the assembly. Do not install lighting fixtures with ventilation holes through the air barrier

Provide a motorized damper in the closed position and connected to the fire alarm system to open on call and fail in the open position for any fixed open louvers such as at elevator shafts. Damper and control to close all ventilation or make-up air intakes and exhausts, atrium smoke exhausts and intakes, etc when leakage can occur during inactive periods. Compartmentalize garages under buildings by providing air-tight vestibules at building access points. Provide air-tight vestibules at building entrances with high traffic.

Compartmentalize spaces under negative pressure such as boiler rooms and provide make-up air for combustion.

### 2.2 Building Air Leakage Testing – Performance Requirement and Substation:

1. Submit the qualifications and experience of the testing entity for approval.
2. Demonstrate performance of the continuous air barrier for the building envelope by the following tests:
  - a. Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed 0.25CFM/sq ft at a pressure differential of 0.3 in. wag (75 Pa) in accordance with ASTM E- 779 (2003) or E- 1827-96 (2002). Accomplish tests using BOTH pressurization and depressurization. Divide the average measured air leakage flow rate in both directions in CFM @ 0.3 in. wag (L/s @ 75 Pa) by the surface area of the envelope enclosed by the continuous air barrier of the building, including roof or ceiling, walls and floor to produce the air leakage rate in CFM/sq ft @ 0.3 in. wag (L/s.m<sup>2</sup> @ 75 Pa). Do not test the building until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner.
  - b. Test the completed building using Infrared Thermography testing. Use infrared cameras with a resolution of 0.1 °C or better. Perform testing on the building envelope in accordance with International Organization for Standardization (ISO) 6781:1983 and ASTM C1060-90(1997). Determine air leakage pathways using ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier

Systems, and perform corrective work as necessary to achieve the whole building air leakage rate specified in (a.) above.

- c. Notify the Government at least 3 working days before the tests to provide the Government the opportunity to witness the tests. Provide the Government written test results confirming the results of all tests.

Existing buildings undergoing major renovations (especially the ones located in cold or hot and humid climates) shall be sealed to the same standard as newly constructed ones.

### 3 Specifier and Witness Guidance

#### 3.1 Application and Scope

Use this Guide to gain a general understanding of the air leakage test, how it should be specified, and how to monitor whether the air leakage test has been properly performed. This air leakage test specification and the required pass/fail result must be applied to the entire exterior enclosure area as a single entity. See the included glossary (p 26) for definitions. In many circumstances, it is useful (but not currently required) to isolate components such as individual walls or floors to diagnose more closely the source of air leakage. In the future, individual components such as horizontal floor slabs may have their own more stringent requirements, but for now, only the air leakage of the entire exterior envelope is measured.

The architect or design engineer is responsible for defining the bounds of the enclosure and for calculating its surface area to be used in the results calculation. The surface area will include the floor, walls/fenestrations, and roof/ceiling. This enclosure is often the “exterior envelope” of the building, but does not always include all exterior walls. Of interest is the functional “air barrier” for the enclosure under test, which may not be the exterior envelope. For example, heating, ventilating, and air-conditioning (HVAC) rooms with large louvers open to outdoors, laundry rooms with dampers opening to outdoors, and loading docks with overhead coiling may be outside the air barrier enclosure if the design dictates such. This would force their interior walls to be insulated and air sealed to the same standard as other parts of the enclosure that face the outdoors.

The boundary of the air barrier must be clearly defined in the project drawings. Once properly considered by the design professional, the calculated surface area of the air barrier should be indicated on the design drawings.

For buildings where doorways from each apartment, office, meeting room, or other area that open from a common hallway or zone and not at the air barrier boundary, the entire building air barrier system must be tested as a whole.

For buildings where doorways of each apartment/office/room lead to the outdoors (i.e., where there is no direct interior connection between all the rooms), each apartment/office/room must be tested individually. Walls abutting adjacent apartments are to be treated as part of the envelope in spite of the fact that an argument can be made that leakage of the adjacent walls would be to another conditioned apartment and could therefore be ignored. To allow for efficient testing, common walls will be treated as part of the total envelope for the apartment and each apartment must pass the criteria. In multi-unit apartments, each style of apartment must be tested, including all corner rooms, and at least 20 percent of all other apartments must be tested.

Buildings over 500,000 sq ft. of envelope area may require special test techniques not covered in this protocol. The building may have to be broken up into zones separated using boundary pressure neutralization techniques or by the erection of temporary walls. In other cases, the use of the building HVAC or large truck mounted fans may be required to establish useful test pressures. These special techniques will require a higher level of experience and engineering to establish useful results. It is up to the specifier to establish conformance criteria and test procedures for these unique buildings. The Canadian General Standards Board (CGSB) standard CAN/CGSB-149.15, *“Determination of the Overall Envelope Airtightness of Buildings by Fan Pressurization Method Using the Building’s Air Handling Systems”* could be referenced by the specifier and used by the testing agency. However, the importance of air tightness should not be lost on buildings with enclosures over 500,000 sq ft.

#### 3.2 Air Leakage Specification

The air leakage test specification could be written as follows:

The air leakage test must be performed in accordance with ASTM E- 779 with the following additions and exceptions shown below.

The test consists of measuring the flow rates required to establish a minimum of 12 positive and 12 negative building pressures. The lowest test pressure shall be 25 Pa; the highest test pressure shall be 75 Pa; and there must be at least 25 Pa difference between the lowest and highest test pressures. The test pressure must be measured in a representative location such that pressures in the extremities of the enclosure can be shown to not exceed  $\nabla 10\%$  of the measured test pressure. At least 12 bias pressure readings must be taken across the envelope and averaged over at least 20 seconds each before and after the flow rate measurements. None of the bias pressure readings must exceed 30 percent of the minimum test pressure when testing in both directions. Where it can be shown that it is impossible to test in both directions, then the building may be tested in the positive direction only, provided the bias pressure does not exceed 10% of the minimum test pressure.

The mean value of the air leakage flow rate calculated from measured data at 0.3 in wg (75 Pa) must not exceed 0.25 cu ft/ minute per square foot of envelope area (0.25 CFM<sub>75</sub>/ft<sup>2</sup>) and the upper confidence limit as defined by ASTM E-779 must not exceed (0.27 CFM<sub>75</sub>/ft<sup>2</sup>) or the upper confidence limit must not exceed (0.25 CFM<sub>75</sub>/ft<sup>2</sup>). Measurements must be referenced at standard conditions of 14.696 psi (101.325 KPa) and 68F (20°C). The envelope area is to be supplied and/or confirmed by the architect of record (AOR).

#### Additional information for the specifier

The Testing Agency Guide provides detailed information as to exactly how the test must be performed. The Air Leakage Test Form details the exact procedure that the testing agency followed. A completed test must consist of all pages of the Air Leakage Test Form with required attachments plus a seventh page titled Air Leakage Test Results, upon which the testing agency must make a pass or fail declaration.

Of note to anyone specifying the air leakage test, or under the requirement of an air leakage test, is that:

1. The test is conducted with ventilation fans and exhaust fans turned off and the outdoor air inlets and exhaust outlets sealed (by dampers or masking). In some cases, recirculating air handlers may also need to be turned off. The contractor must provide a responsible HVAC technician with the authority to place the HVAC system in the correct mode for the pressure test. The testing agency must have unhindered access to mechanical rooms, air handlers, exhaust fans, and outdoor air and exhaust dampers.
2. Portable pressurization door fans manufactured for the purpose of pressure testing buildings often require significant electrical power (e.g., 20 amps) and may trip circuit breakers. The contractor must have someone on site with access to and the authority to reset circuit breakers or must have access and authority granted to them.
3. Airflow and enclosure pressure differences are drastically affected when exterior doors or windows are opened. At the time of the test, if subcontractors are still working in the building, the contractor must ensure that all windows in the bounding enclosure are kept closed. Entry and exit through doors in the test enclosure must be eliminated during the test. Data collected while the pressures and flows are affected by a door opening and closing must be discarded.
4. Portable fan pressurization doors are placed in doors or windows in the bounding enclosure. The testing agency must have access to these locations, be able to open them, and to remove closure hardware that interferes with equipment set-up.
5. The contractor shall ensure that no sub-contractors are working in the area of the fan pressurization test equipment. During pressurization tests, air will be blown into the building at high enough velocity that it will cause debris, dust, and litter to become air borne. When exhausting nearby debris and litter may be drawn to the fan guards or become entangled in fan blades where it can block airflow and result in erroneous measurements.
6. The fan pressurization test to determine final compliance with the airtightness requirement shall be conducted when all components of the air barrier system have been installed and inspected, and have passed any

intermediate testing procedures as detailed in the construction drawings and specifications. The test may be conducted before finishes that are not part of the air barrier system have been installed. For example, if suspended ceiling tile, interior gypsum board, or cladding systems are not part of the air barrier system, the test may be conducted before they are installed.

7. The testing agency is required to perform a diagnostic evaluation in accordance with ASTM E1186, whether the building achieves the air tightness requirement or not. The diagnostic evaluation will assist the contractor and responsible parties in identifying and eliminating air leakage so the building meets the requirement upon re-testing. The testing results will also be expressed in terms of the Equivalent Leakage Area (EqLA) at 75 Pa. The EqLA is a the equivalent area of a flat plate that leaks the same amount as the building envelope at 75 Pa. This information helps those responsible for further sealing the envelope know the approximate size of total hole area they should be seeking. Air leaks can consist of many small cracks, or a few very large openings or a combination of both. It is not unusual for large buildings to have a leakage area of up to 100 sq ft. Is also common for air sealing efforts to be focused on the small cracks while large holes that are a major contributor to failing the test, go unnoticed. Even if the building achieves the air tightness requirement, a diagnostic evaluation should be conducted to help the construction team identify additional areas of leakage that could be sealed on the current building or similar future buildings.



## 4 Testing Agency Guide

### 4.1 U.S. Army Corps of Engineers (USACE) standard for air leakage

The USACE requires all new buildings to pass an air leakage test where the results are less than or equal to 0.25 CFM/sq ft of exterior envelope at 75 Pa pressure at standard conditions.

### 4.2 USACE Procedure

The following sections provide useful background information that will give the testing agency more information so that they can more easily understand the step-by-step approach in the Air Leakage Test Form and the Air Leakage Test Form Guide. This test protocol was developed by the U.S. Army Corps of Engineers with assistance from the private industry using ASTM E- 779-03 as a basis. This protocol includes modifications and adjustments needed to account for the potential for bias pressures (due to wind and stack) that are found in high-rise buildings and unobstructed environments, and to strike a balance between accuracy, repeatability and ease of use with a variety of test equipment, test methods, and testing agencies. The section titled “Technical Justification for Differences with ASTM” (p 22) documents the main deviations from ASTM and the reasons why such deviations may occur.

### 4.3 Application and Scope

See the “Application and Scope” under the Specifier’s Guidance section.

The four-story building shown in Figure 1 (top left) has an enclosure that is described by the shape (bottom left top right), and that is accessed by an exterior stairway with no direct interior connection between floors. It therefore must be tested with multiple door fans simultaneously to measure the total enclosure leakage (top right bottom left). Note that a variety of fan setups are allowed under this protocol as long as a single zone with uniform pressure differentials is achieved.

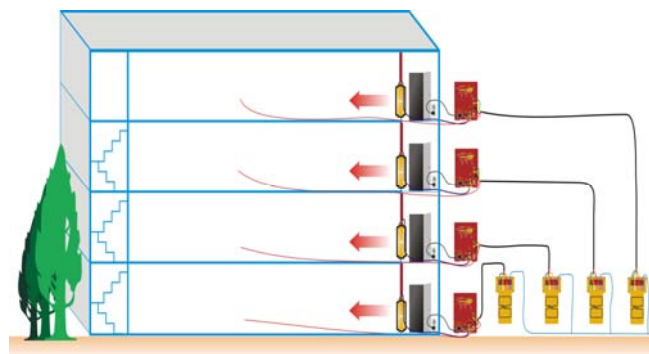
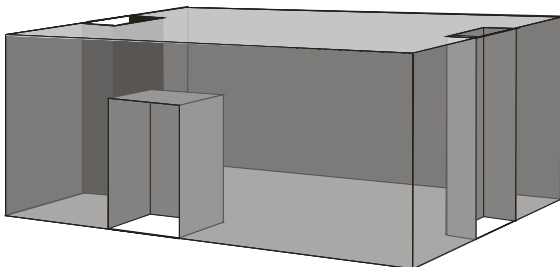
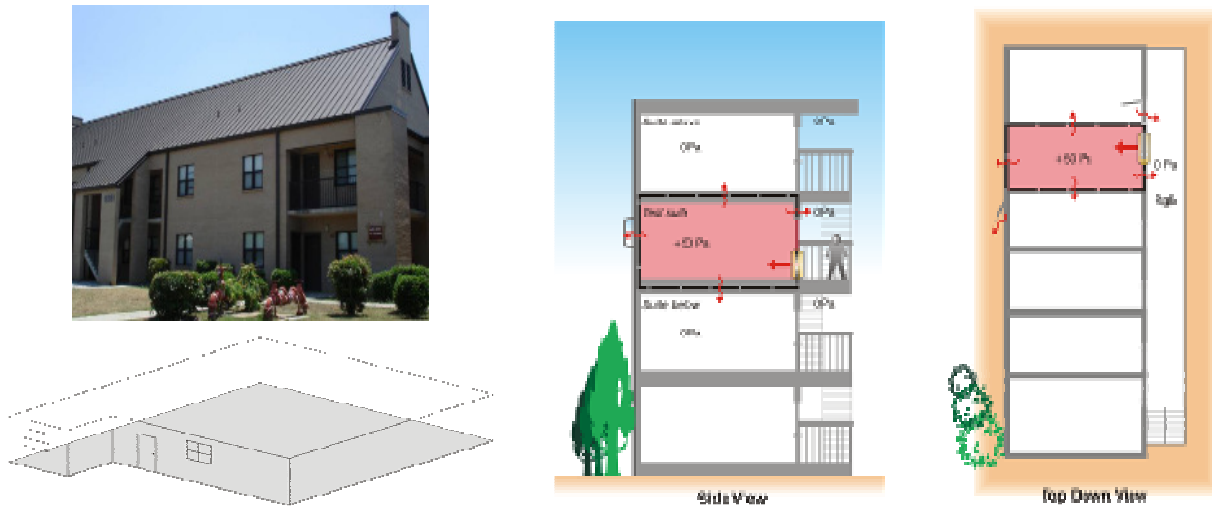


Figure 1. Example four-story building.

In buildings where individual apartments have doors to the outside (Figure 2, top left), the test must be performed on an individual apartment with the adjacent apartments open to outdoors. Perform door fan tests on all corner apartments plus a random 20 percent of those remaining. If they all pass then it can be assumed the rest of the apartments would also pass. Should any one apartment fail, an additional apartment must be added for each failure to the test until at least 90 percent of the tested units pass.



**Figure 2. Example building where individual apartments have doors to the outside**

#### 4.4 Equipment Selection

Since a passing building requires the envelope to attain a leakage rate of 0.25 CFM/sq ft of envelope or less, multiply the envelope square footage that will be tested by 0.25 to get the approximate “passing” CFM needed at a 75 Pa pressure. Using the fan equipment manufacturer’s literature, you can select the amount of airflow-producing equipment needed to perform the test. Portable fans that can test in both positive and negative directions must be used unless it can be shown that it is impossible to do so. The testing agency must have sufficient airflow-producing equipment to achieve at least 100 percent of the required passing CFM under the 0.25 requirement.

For example, if the building had 100,000 sq ft of envelope area, then it would require  $100,000 \times 0.25 = 25,000$  CFM to be supplied by the testing agency. This generally requires the simultaneous operation of multiple portable fans and pressure monitoring equipment strategically placed throughout the building. If the specifications call for an air leakage requirement that is relaxed to a greater leakage rate such as 0.75 CFM/sq ft for special buildings (i.e., storage facilities with overhead coiling doors), then the testing agency should use the 0.25 value as a minimum fan capacity required for the test. Building HVAC systems may be used to measure envelope leakage in some cases where a proficient testing agency is capable of measuring air flows through outdoor air and exhaust ventilation equipment using:

- Pitot tube or hot wire anemometer traverse.
- Pressure compensated shrouds (which work well on rooftop exhaust units, and which are very accurate because they include air from duct leakage as well as through grilles).
- Tracer methods for measuring airflows in ducts (ASTM 2029 Volumetric and Mass Flow Rate Measurement in a Duct Using Tracer Gas Dilution). NOTE: Tracer decay, constant injection and constant concentration methods for estimating total ventilation rate of the test zone itself are prohibited.
- Outdoor air flow stations may be used if one of the above methods is used to check accuracy at least on air flow for each station, or if the design of the HVAC system specifically placed outdoor air flow stations in good measurement locations that are field verified.

For whole building tests on buildings with air handling systems that have been designed to provide accurate outdoor airflow stations or for very large buildings, with over 500,000 sq ft of envelope, this may be the practical option.

The standard CAN/CGSB-149.15, *Determination of the Overall Envelope Airtightness of Buildings by Fan Pressurization Method Using the Building's Air Handling Systems* could be referenced and used by the testing agency. In the hands of experienced personnel, reasonable results may be achieved, but note that accuracies have been no better than  $\pm 20$  percent when 75 Pa was achieved.

It may be possible to isolate and test individual floors for buildings in excess of four stories, if the testing agency's equipment is not capable of achieving a full building uniform pressure due to the geometry of the interior partitions and limited shaft areas. However, the floor-by-floor method requires exceptional preparation and knowledge of airflow characteristics within chases, shafts, and wall cavities, in addition to maintaining an identical or balanced pressure at the floors above and below. Refer to the ASHRAE study, *Protocol for Field Testing of Tall Buildings to Determine Envelope Air Leakage Rate 935-RP* (Bahnfleth 1998) for additional information on the floor-by-floor method of testing. It is recommended that the whole building achieve a uniform pressure to avoid the uncertainty inherent in the floor-by-floor method, but this protocol does not prohibit the application of the floor-by-floor method as an option for buildings greater than four stories in height.

Pressure gauges must be digital and accurate to within  $\pm 1$  percent of reading or  $\pm 0.25$  Pa, whichever is greater, and must have adjustable time averaging to compensate for wind. Calibrated fans must be accurate to within  $\pm 5$  percent of the flow reading. Sufficient tubing must be available so that all gauges used can be manifolded together and referenced to the same outdoor pressure. These tubes will be connected to the negative port of all gauges. Tubing must also be available to run from the center of each separate test zone to the positive port of a gauge.

A minimum of one exterior pressure monitoring station is required. The testing agency is allowed to use additional exterior pressure monitoring stations, especially if bias pressures exceed the values stipulated in Section 4.5 of the Air Leakage Test Form.

The pressure difference between interior zones shall be monitored to determine whether pressure differences between interior locations are within 10 percent of the indoor-outdoor pressure difference during all tests or not. If they are not, then adjustments to test set-up shall be made until they are within 10 percent. Interior pressure difference measurements shall be referenced to a single interior zone that is unaffected by velocity pressure created by test equipment. Thus, at an average 75 Pascal pressure difference across the enclosure, the difference between the highest and lowest interior pressure difference measurements should be within 15 Pascals of each other. The number of indoor pressure difference measurements required depends on the number of interior zones separated by bottle necks that could create significant pressure drops (e.g., doorways and stairwells).

## 4.5 Pre-Test Inspection

A pre-test inspection must be performed to determine whether there is something that would prevent the test from being completed. Check local weather forecasts for rain or strong winds before travelling to the test site. Ensure that the test equipment has arrived at the test site on time, and that it is in operable condition. The operation of the equipment is the simplest part of the test, whereas preparing the building is the most complex, takes the most time, and is the most likely factor to prevent the testing agency from completing the test.

### 4.5.1 Record Set-up Conditions

Accurately record the exact set up conditions. Pictures should be taken of representative setup conditions and should be attached to the final report. The intent of this protocol is to ensure buildings are set-up and prepared in an identical manner so the tests are repeatable. The testing agency is responsible to ensure the building is properly prepared and maintained throughout the test, but the contractor typically performs the actual preparation labor described below.

## 4.5.2 Preparation of the Building

Seal or otherwise effectively isolate all “intentional” holes in the building enclosure. This includes air intake or exhaust louvers, make-up air intakes, pressure relief dampers or louvers, dryer and exhaust vent dampers and any other intentional hole that is not included in the air barrier design or construction. Intentional openings can be sealed by using an air-tight film or by motorized or manual dampers held in the closed position.

NOTE: Exterior windows and doors (fenestrations) are not intentional openings. Fenestrations are included in the air barrier test boundary. Exterior windows and doors shall be in the closed and locked position only; no additional films or additional means of isolation at fenestrations is allowed.

Ensure that all plumbing traps are filled with water.

The HVAC system must be shut down or disabled for the duration of the test. If the HVAC system activates during the test, additional air movement across the enclosure is introduced and is not measured by the agency, resulting in inaccurate data.

All interior doors that access the building enclosure (roof, walls and fenestrations, floor) must be held open during the test to create a single uniform zone. If the door services only an interior room such as a storage closet, it is allowed to remain closed only if a dropped ceiling plenum is present above and it does not access an air barrier boundary. If doorways cannot be opened and the volume on the other side of the door is considered to be within the envelope, then the pressure across that doorway must be measured with the door fan running to ensure that the pressure on the other side of the door, as measured with an under door probe, is within  $\pm 10\%$  of the average building pressure.

Buildings with a dropped ceiling plenum must have tiles removed at a rate of one per every 500 sq ft. Additional tiles may be removed at the discretion of the testing agency so a uniform pressure distribution in the plenum space is achieved.

Combustion equipment must be disabled or be in the “pilot” position.

If the test zone is within a larger building enclosure such as a Tactical Equipment Maintenance Facility or Company Operations Facility, the areas outside of the test zone must be at ambient (outdoor) conditions. This can be achieved by open man-doors or overhead coiling doors in the open position.

Optional: Set-up the door fan and run preliminary test

If using door fans to pressurize the air barrier, perform a test with only one door fan. Occasionally, no additional testing will be required, as a preliminary test can help determine the following:

1. The quantity of additional door fans needed to achieve the desired test pressure.
2. A rough estimate as to whether the enclosure could pass, which may force the testing agency to spend more time investigating enclosure problems, instead of using time to verify an obvious failing enclosure.

For the preliminary test:

1. Record interior and exterior weather conditions
2. Record average and maximum wind speed and direction at least 5-feet off the ground and 25-feet away from the building in the direction of the wind.
3. Record interior and exterior temperatures before and after the test.
4. Record site elevation in feet above sea level.
5. Perform a multi-point test in both directions from at least + 25 to + 50 Pa, then - 25 to - 50 Pa.

Because this test is performed by pressurizing and depressurizing the air barrier envelope, bias pressure effects are minimized, yielding more accurate results. This is the preferred test method since it is not only more tolerant of test conditions, but also gives a more accurate representation of the envelope leakage under ambient conditions, where pressures can be either positive or negative in direction. Bias pressures may be up to 30 percent of the lowest test pressure, allowing this method to be used in a wider range of weather conditions. If fan power is sufficient, then

testing up to 75 Pa would be even more accurate and would allow tests to be completed where bias pressures were higher.

The testing agency must achieve at least 50 Pa, but there is no requirement that it must achieve a maximum pressure of 75 Pa. The agency is encouraged to achieve the highest building pressure possible, but should not exceed 75 Pa.

It is noted that some buildings will have air barrier systems that have not been properly designed and/or installed, resulting in the maximum building pressure being less than 50 Pa. Although the building does not meet the air leakage requirement of 0.25 CFM/sq ft, the testing agency must still perform a multi-point test in general accordance with this protocol so an approximate air leakage value can be provided to the prime contractor. This will allow them to estimate the magnitude of the repairs necessary to meet the air leakage requirement.

## 4.6 Reporting of Results

The data collected during the multi-point tests will be corrected for standard conditions and used to determine the air leakage coefficient,  $C$ , and the pressure exponent,  $n$ , in accordance with ASTM E779-03, from:

$$CFM = C * \Delta P^n$$

In general, the  $C$  and  $n$  values are obtained by plotting the data in log-linearized fashion to obtain a curve fit that will produce the required coefficients. The testing agency must use a minimum of 12 data points from each test, but is not limited to the maximum number of data points taken during the test. It is recommended to take additional data points so in the analysis the “outliers” can be omitted from the calculation procedure. Outliers are most frequently caused by wind gusts, changes in wind direction at the time that data pair was recorded, among other reasons.

One flow rate must be calculated for both the pressurization and depressurization tests at a  $\Delta P$  of 75Pa (CFM@75Pa). The average of those CFM values will be divided by the enclosure area given in the project drawings to determine the normalized air leakage rate. This average value will be used as the basis for determination if the building meets or does not meet the requirement of 0.25 CFM/sq ft<sub>envelope</sub>@75-Pa. The value is to be rounded to the nearest hundredth. Therefore, a value of 0.255CFM/sq ft does not meet the USACE requirement.

In addition to reporting the normalized air leakage as CFM/sq ft<sub>envelope</sub>@75Pa, the agency is also required to report the correlation coefficient ( $r^2$ ) and 95 percent Confidence Intervals (95%CI) to determine the accuracy of the data collected and the quality of the relationship between flow and pressure that was established during the test. The 95%CI should be calculated in strict accordance with the methodology contained in ASTM E779-03 and the  $r^2$  value can be obtained by data analysis of the plotted data.

In general, a narrower 95%CI to the mean value and higher  $r^2$  value indicates a clear relationship for the building's air leakage characteristics was established. For the collected data to be statistically significant, the 95%CI must not exceed  $\nabla 0.02$  for mean values of 0.25 or less, which equates to approximately 8 percent. For example, if the calculated mean value is 0.25 and the 95%CI is shown to be 0.23 to 0.27, the test data is statistically significant. However, if the mean value is 0.25 and the 95%CI is 0.16 to 0.33, this exceeds 0.02 and indicates that the data is not statistically significant, and that a clear relationship between flow and pressure was not established during the test; the test must be repeated. In cases where the 95%CI exceeds  $\nabla 0.02$ , but the upper limit is 0.25 or less, the test would be considered a pass in spite of the statistical insignificance because there is a strong likelihood that the building passes the requirement. Likewise, the  $r^2$  value must be above 0.98 for the data to be statistically significant. Test data should have correlations above 0.99.

Similarly, the pressure exponent,  $n$ , will also provide some insight as to the accuracy of the test and relative tightness of the building enclosure. Exponent values less than 0.5 or greater than 1.0 in theory indicate a bad test, but in practice, tests outside the range of 0.45 to 0.8 would generally indicate an inaccurate test or calculation methodology. The reason comes down to basic fluid dynamics and the characteristics of developing airflow through orifices, which is too lengthy to discuss within this protocol. Except for very rare circumstances,  $n$  values should not take on values less than 0.45 or greater than 0.8. If the  $n$  value exceeds these boundaries, the test must be repeated. In general, an  $n$  value closer to 0.5 indicates large holes that are much shorter in length than they are wide, where an

$n$  value above 0.65 indicates the hole characteristics that are smaller cracks or holes that are much longer than they are wide. Most “tight” residential homes exhibit an  $n$  value of 0.60 to 0.65, where larger buildings will likely have an  $n$  value slightly less.

The testing agency is required to produce the data used in the analysis and results in tabular and graphical form, including the curve fitted coefficients and correlation coefficient.

Several common conditions that will cause test results to be very low are:

1. Interior pressure monitoring stations are placed too close to direct air flow that is typically produced by the test fans.
2. Usually tests are conducted with the fan orifice fully open, allowing maximum airflow. For testing smaller envelopes that require smaller test flows, a flow restriction device such as a plug or plastic ring can be installed on the fan. When limiting the fan air flow, the gage manufacturer requires that the digital gage's configuration be adjusted. If the gauge is incorrectly set on a lower range than the fan, then the measured flow will be much lower than the actual flow.
3. Interior doors have been left closed.
4. Exterior envelope is very tightly sealed.

Several common conditions will cause results to be very high are:

1. Intentional openings have not been properly sealed or have opened during the test (i.e., pressure relief dampers, plumbing traps).
2. Windows or exterior doors are left open.
3. HVAC equipment is not properly disabled.
4. If the gauge is set on a higher range than the fan, then the measured flows will be much higher than the actual flow.
5. It is possible the building contains significant holes in the air barrier enclosure and the high readings are simply an indication of the performance of the building.

#### **4.7 Locating Leakage Sites with Pressurization and Depressurization**

If the building fails the test, it is important to determine the source of the air leakage. It is also beneficial for the design-build team to understand the locations and details that are susceptible to leakage, even if the building as a whole passes the test. The testing agency is required to perform a diagnostic evaluation in accordance with ASTM E1186. The testing agency can use additional methods to discover leaks.

Neutral buoyancy smoke, theatrical smoke and infrared (IR) are effective means to find leakage sites. When testing equipment pressurizes the enclosure, air leaks can be seen from outdoors (provided exterior walls have not been heated by radiation from the sun) using infrared thermography or large scale smoke generation. When testing equipment depressurizes the enclosure, air leaks can be observed from the inside using infrared thermography and smoke generation. The manipulation of the HVAC system is required to perform an effective infrared thermography scan to achieve a temperature differential of at least 10 °F.

An Infrared Training Center (ITC) Level I Certified Infrared Thermographer is required by this protocol to perform the infrared diagnostic evaluation. Otherwise, the agency must submit the qualifications of the infrared thermographer, who must have at least 5 years experience in building science applications with infrared thermography. Anomalies such as thermal bridges and emissivity reflections are commonly mistaken as air leakage. The testing agency must employ thermographers with experience in building enclosures and building physics to achieve accurate diagnoses and to make effective recommendations to the design-build contractor in the event of failure and repair.

In general, when locating leaks, the airflow equipment should be adjusted to establish a minimum of +25 Pa pressure differential to use smoke and infrared while viewing the building from outdoors. A pressure differential of -25 Pa should be used for using infrared from the interior. Additional information is required in the diagnostic evaluation in accordance with ASTM E1186.

5 Air Leakage Test Form

For buildings constructed in compliance with the U.S. Army Corps of Engineers Air Leakage Protocol

Building name: \_\_\_\_\_

Building address: \_\_\_\_\_

Prime Contractor: \_\_\_\_\_ Contact: \_\_\_\_\_

Testing agency: \_\_\_\_\_

Address: \_\_\_\_\_

Testing Agency Contact: \_\_\_\_\_ Phone: \_\_\_\_\_

Lead on-site personnel: \_\_\_\_\_ Phone: \_\_\_\_\_

Test date: \_\_\_\_\_

Witnesses:		
Name	Organization	Telephone/email
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

INSERT PHOTOGRAPH OF SUBJECT BUILDING

Testing agency to provide a Compact Disk (CD) with digital photographs of subject building, setup, test procedures, and diagnostic evaluation.

Step	Description	Result
1	<b>Enclosure Area:</b> Record the total exterior enclosure surface area including walls, floor and ceiling from design plans as supplied by the Architect of Record (AOR). Verify the dimensions used by the AOR in the calculations match as-built conditions and that the arithmetic was performed correctly.	sq ft
NOTE: Testing agency to attach a description of the building characteristics, including intended use, wall, roof, and floor construction, fenestrations, HVAC system, air barrier system, and any additional information that may be relevant to the air leakage test.		

2	Set Up Checklist				
2.1	Confirm HVAC shutdown/disabling.		2.2	Confirm all dampers in the enclosure perimeter are closed and/or isolated.	
2.3	Confirm exhaust fans & dryers are off and isolated at the enclosure level.		2.4	Confirm combustion appliances are on pilot or are disabled.	
2.5	Confirm all air inlets at the enclosure perimeter are sealed or isolated.		2.6	Confirm all interior doors are propped open.	
2.7	Confirm all air outlets at the enclosure perimeter are sealed or isolated.		2.8	Note rain or snow conditions that may be affecting leakage of walls.	
2.9	Confirm exterior doors and windows are closed and latched.		2.10	Confirm ambient conditions provided are outside of air barrier envelope.	
2.11	Confirm all plumbing traps are filled with water.		2.12	Confirm dropped ceiling tiles are removed at specified rate.	
2.14	Confirm uniform interior pressure distribution by establishing at least 30 Pa and using a minimum of four pressure monitoring stations with one common exterior pressure monitoring station. Measure pressures at the four interior stations to ensure the interior pressure is within $\pm 10\%$ of target value. List interior stations and pressures measured: Interior Station Locations: _____ _____ _____ _____ _____ _____ Pressure: ____ Pa ____ Pa ____ Pa ____ Pa				



2.15	Describer the approximate locations of the exterior pressure monitoring stations and whether the stations will be manually averaged or a manifold used. Exterior Station Locations:        Means of averaging: _____
Additional Set up notes:    	

3	Testing equipment used			
Gage 1	Model:	Serial #:	Accuracy:	Calibration Date:
Gage 2	Model:	Serial #:	Accuracy:	Calibration Date:
Gage 3	Model:	Serial #:	Accuracy:	Calibration Date:
Gage 4	Model:	Serial #:	Accuracy:	Calibration Date:
The gage must have an accuracy of $\pm 1\%$ or 0.5 Pa, whichever is greater and must have had its calibration checked against a National Institute of Standards and Technology (formerly National Bureau of Standards, or NIST) traceable standard within 2 years.				
Fan 1	Model:	Serial #:	Accuracy:	Calibration Date:
Fan 2	Model:	Serial #:	Accuracy:	Calibration Date:
Fan 3	Model:	Serial #:	Accuracy:	Calibration Date:
Fan 4	Model:	Serial #:	Accuracy:	Calibration Date:
The fan must have an air flow measurement accuracy of $\pm 5\%$ percent of the measured flow and must have had its calibration checked against a NIST traceable standard within 5 years.				
Infrared Camera	Model:	Serial #:	Accuracy:	Calibration Date:
The infrared camera must have a sensitivity of $\nabla 0.1^\circ\text{C}$ and must have been calibrated within 1 year of the test date.				
Attach calibration certificates for all equipment listed above to air leakage test form. If additional fans or gauges are used during the test, attach calibration certificates.				

<b>4</b>	<b>Perform a multipoint pressurization door fan test</b>																			
4.1	Record indoor and outdoor temperatures before and after the test.	Indoor Pre-Test				Indoor Post-Test														
		Outdoor Pre-Test:				Outdoor Post-Test:														
4.2	Record wind speed and direction	Average mph				Direction														
4.3	Record elevation of building above sea level.										ft									
4.4	Record 12 <b>Bias Pressure Test Points</b> where each test point consists of at least 12 readings taken over at least 10 seconds. Show positive and negative signs.																			
<b>Bias Pressure Test Points</b>		1	2	3	4	5	6	7	8	9	0	11	12							
		Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa							
4.4.1	Record the magnitude of the greatest <b>Bias Pressure Test Point</b> .										Pa									
4.4.2	Record the amount of time taken to collect each <b>Bias Pressure Test Point</b> .										sec									
4.5	If this value is 15 Pa or less, proceed with step 4.6. If greater than 15 Pa, repeat step 4.3 over a longer time period.																			
<p><b>Pressurization test.</b> Adjust the door fan speed to establish a series of a minimum of 12 equally spaced <b>Building Pressure Test Points</b> where each <b>Test Point</b> is an accumulation of at least 10 readings taken over a time period that is at least double the time taken to collect <b>Bias Pressure Test Points</b> in 4.4.</p> <p><b>Testing in two directions:</b> the minimum test pressure must be at least 25 Pa and must also be at least the absolute value of greatest <b>Bias Pressure Test Point</b> <math>\times 10/3 =</math> _____ Pa. The maximum test pressure should be at least 25 Pa greater than the minimum test pressure. The testing agency is required to supply 100% of the estimated "passing" flow using <math>0.25 \text{ CFM/sq ft}_{\text{envelope}}</math> to estimate the passing flow.</p>																				
4.6	Record the actual <b>Building Pressures</b> (Pa) from one or more interior pressure monitoring stations and the exterior pressure station(s), averaged or manifolded, with corresponding <b>Flows</b> (CFM) for each fan.																			
4.6.1	Attach to this test form the results of the pressure and flow readings taken during the test. Results should be provided in tabular and graphical form. Graph should include correlation coefficient ( $r^2$ ) and plotted in log-linearized fashion. A minimum of 12 points must be provided, but the testing agency is allowed to take additional data points to assist in data analysis and increase the accuracy of the test. There is no limit to the number of data points taken during the test, but a minimum of 12 must reported for data analysis and results.																			
4.7	Record the amount of time to be taken to collect each <b>Building Pressure Test Point</b> .										sec									

4.8	Record 12 <b>Bias Pressure Test Points</b> over the same time periods as step 4.4.												
Bias Pressure Test Points		1	2	3	4	5	6	7	8	9	10	11	12
		Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa
4.9	Calculate the <b>Average Bias Pressure</b> for all 24 <b>Test Points</b> taken in step 4.										Pa		
4.10	Subtract value in 4.9 from all pressure readings taken in 4.6. This is the total corrected building pressure used in the analysis. See step 6.												

<b>5.</b>	<b>Perform a multipoint depressurization door fan test</b>												
Testing in both directions is the preferred method, but if in section 4.6 if it was noted that the test was to be performed in only one direction, then step 5 can be omitted.													
5.1	Record indoor and outdoor temperatures before and after the test.						Indoor Pre-Test		Indoor Post-Test				
							Outdoor Pre-Test:		Outdoor Post-Test:				
5.2	Record wind speed and direction						Average mph		Direction				
5.3	Record elevation of building above sea level.										ft.		
5.4	Record 12 <b>Bias Pressure Test Points</b> where each test point consists of at least 10 readings taken over the time period determined in step 4.5. Show positive and negative signs.												
Bias Pressure Test Points		1	2	3	4	5	6	7	8	9	10	11	12
		Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa
5.4.1	Record the magnitude of the greatest <b>Bias Pressure Test Point</b> .										Pa		
5.4.2	Record the amount of time taken to collect each <b>Bias Pressure Test Point</b> .										____sec		
<b>Depressurization test.</b> A pressurization test must already have been performed. Take depressurization test points at the same absolute values of <b>Building Pressure</b> as used in section 4.													
5.5	Record the actual <b>Building Pressures</b> (Pa) from one or more interior pressure monitoring station and a minimum of four exterior pressure stations, averaged or manifolded, with corresponding <b>Flows</b> (CFM) for each fan.												
5.5.1	Attach to this test form the results of the pressure and flow readings taken during the test. Results should be provided in tabular and graphical form. Graph should include correlation coefficient ( $r^2$ ) and plotted in log-linearized fashion. A minimum of 12 points must be provided, but the testing agency is allowed to take additional data points to assist in data analysis and increase the accuracy of the test. There is no limit to the number of data points taken during the test, but a minimum of 12 must be used for data analysis and results.												
5.4	Record the amount of time taken to collect each <b>Building Pressure Test Point</b> .										sec		

5.7	Record 12 <b>Bias Pressure Test Points</b> in exactly the same fashion as step 4.4.													
Bias Pressure Test Points	1	2	3	4	5	6	7	8	9	10	11	12		
	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa		
5.8	Calculate the <b>Average Bias Pressure</b> for all 24 <b>Test Points</b> taken in step 5.										Pa			
5.9	Subtract value in 5.8 from all pressure readings taken in 4.6. This is the total corrected building pressure used in the analysis. See step 6.													
<b>6.</b>	<b>Calculate and Report Results</b>													
Subtract the <b>Average Bias Pressure</b> from all <b>Building Pressures</b> to arrive at <b>Corrected Building Pressure</b> . Curve fit pressures and flows from the tables and calculate the following values in strict accordance with ASTM E779-03. Provide tabulated and graphical data as an attachment to this test form.														
	<b>Pressurization</b>													
6.2	The air leakage coefficient $C_p$ for									CFM/Pa <sup>n</sup>				
6.3	The exponent $n_p$ for pressurization. (NOTE: if $n_p$ is less than 0.45 or greater than 0.8, test data is invalid and test must be repeated.)													
6.4	CFM referenced to standard temperature and pressure (STP) at +75 Pa.									CFM				
6.5	CFM/sq ft of envelope at +75 Pa									CFM@75/sq ft				
6.6	The correlation coefficient, $r^2$ , of the curve fitted data with a minimum of 12 points. (NOTE: if $r^2$ is less than 0.98, test data is invalid and test must be repeated.)													
6.7	Calculate the 95% confidence interval at +75 Pa for test in pressurization. (NOTE: if the upper confidence interval exceeds 0.27 the test data is invalid and test must be repeated. If the upper confidence limit is 0.25 or more and the lower confidence limit is 0.04 lower, the test data is invalid and the test must be repeated.)									CFM@75/sq ft CFM@75/sq ft				
	<b>Depressurization</b>													
6.8	The air leakage coefficient $C_d$ for depressurization.									CFM/Pa <sup>n</sup>				
6.9	The exponent $n_d$ for depressurization. (NOTE: if $n_p$ is less than 0.45 or greater than 0.8, test data is invalid and test must be repeated.)													
6.10	Calculate CFM referenced to STP at -75 Pa.									CFM				
6.11	CFM/sq ft of envelope at -75 Pa									CFM@75/sq ft				
6.12	The correlation coefficient, $r^2$ , of the curve fitted data with a minimum of 12 points. (NOTE: if $r^2$ is less than 0.98, test data is invalid and test must be repeated.)													
6.13	Calculate the 95% confidence interval at +75 Pa for test in pressurization. (NOTE: if the upper confidence interval exceeds 0.27 the test data is invalid and test must be repeated. If the upper confidence limit is 0.25 or more and the lower confidence limit is 0.04 lower, the test data is invalid and the test must be repeated.)									CFM@75/sq ft CFM@75/sq ft				

	<b>Both Pressurization and Depressurization</b>	CFM
6.14	Calculate the average CFM/sq ft from 6.5 and 6.10	CFM@75/sq ft
6.15	Building passes if the value 6.14 is less than 0.25 CFM/sq ft at 75 Pa.	Pass/fail
6.16	For the purpose of visualizing the magnitude of the air leakage of the enclosure, calculate the equivalent leakage area in square feet at 75 Pa.	sq ft
7.	Perform a diagnostic evaluation in accordance with ASTM C1060 and ASTM E1186. Attach results of diagnostic evaluation to this test form.	

<b>8.</b>	<b>Restore the building to pre-test conditions</b>
-----------	--

## 6 Air Leakage Test Results

### Testing Agency Certified Compliance with U.S. Army Corps of Engineers air leakage protocol

1	The enclosure area was obtained from the architect of record and was checked on site for reasonableness.	Initial
2	Set up conditions were performed according to section 2 and all deviations and their impact noted.	initial
3	Test equipment used was in compliance respect to accuracy and calibration date.	Initial
4	The test procedure used was in compliance except as noted here.	initial
5	The calculations were done in strict accordance with ASTM E779-03 except as noted in the Protocol.	initial
6	Provide the value calculated in step 6.14.	CFM@75/sq ft
7	Building passes if the value in step 6.14 is less than 0.25 CFM/sq ft <sub>envelope</sub> at 75 Pa.	Pass/fail
8	All accuracies, pressure limits and data correlations and confidence intervals are within the bounds specified in sections 4, 5 and 6 and all deviations are noted.	
9	Supporting documentation described in 1, 3, 4.6.1, 5.5.1, and 7 is attached to this test form, including all digital photographs of the building and test procedure.	initial

I hereby certify that the results above are in conformance with the U.S. Army Corps of Engineers protocol.

Testing Agency Name

\_\_\_\_\_

Testing Agency Authorized Representative Signature

\_\_\_\_\_

Testing Agency Authorized Representative Printed Name

\_\_\_\_\_

Date \_\_\_\_\_

## 7 Technical Justification for Differences with ASTM

### 7.1 Development of this Standard

The development of this standard and the associated testing protocol considered virtually every standard in widespread use. Standards that played an important part in this development were:

- ASTM E779-03 “Standard Test Method for Determining Air Leakage Rate by Fan Pressurization”
- ASTM E1827-96 “Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door”
- The Canadian Building Code
- Various applicable ASHRAE standards
- Air Tightness Testing and Measurement Association (ATTMA) Technical Specification 1 (United Kingdom [UK])
- CGSB 149.10, Canadian air leakage standard.

Key differences among these standards are:

- Choice of test pressures (10 Pa, 50 Pa versus 75 Pa)
- Way of expressing results (EqLA, CFM50, ACH50, CFM/sq ft @ 75Pa)
- Necessity and method for accounting for bias pressures (called “zero flow pressures” for the pressure measured with zero flow going through the door fan).
- Necessity and method for accounting for additional parameters (barometric pressure, humidity, temperature, elevation).

Both ASTM standards were originally intended for the testing of residential detached housing. Under these standards, multiple test points are gathered from 10 Pa up to 60 Pa and results are expressed in CFM @ 50 Pa or air changes per hour (ACH) @ 50 Pa (where CFM @ 50 Pa is the flow rate, in CFM, required to depressurize the house to – 50 Pa). It is also referred to as “CFM at 50 Pa,” “CFM @ 50,” or simply “CFM50.” ACH @ 50 Pa is CFM50 divided by the house volume. It is also referred to as “Air Changes at 50 Pa” or “ACH50”). The other commonly required result is Effective Leakage Area (EflA) at 4 Pa (which is not to be confused with EqLA).

Both ASHRAE and the Canadian Building Code use testing points up to 75 Pa and express their results in terms of flow per square foot of surface area at 75 Pa.

The preferred test method for this standard includes:

1. Multiple test points from 75 Pa to 25 Pa
2. Testing in both the pressurization and the depressurization directions
3. Taking a comprehensive bias pressure over a long time interval to determine the lowest possible test pressure and to provide a more accurate bias correction
4. Expressing results in terms of CFM @ 75 per sq ft of enclosure area

The higher test pressure of 75 Pa was chosen for this standard since larger buildings are subject to higher bias pressures from wind and stack effects. Since wind velocity increases with height above ground, higher pressures due to wind are experienced. As height doubles, the increased bias pressures experienced due to wind roughly double. Houses typically experience bias pressures of 2 to 5 Pa whereas larger buildings can experience 10 to 20 Pa. Taking results at higher pressures helps achieve a more consistent result. A 75 Pa test pressure is about as high a pressure as is practical without vastly increasing door fan power, which would substantially increase the risk of damage due to higher wind velocities and pressures, and which is about the maximum a well-hung suspended ceiling can withstand without tearing it down in depressurize mode or blowing the tiles out in pressurize mode.

A sensitivity analysis was done on the sixth floor of an office building. Data was gathered in no-wind conditions and in conditions with a 10 to 15 mph wind blowing. Six test points were taken per test except for tests in both directions where six points were taken in each direction. Results were measured in CFM at 75 Pa. Twenty-three tests were performed under low wind conditions and another 26 tests were performed under windy conditions. All low wind tests were averaged and that average was used as the true result. The deviation result shown was the average deviation from the true result.

Direction	Pressure range	No wind CFM75			
		Deviation (%)	Error range (%)	Deviation (%)	Error range (%)
Depressurize with Bias	-60 to -12.5 Pa	2	-2.5 to + 1.5	17	-24 to -10
Depressurize with Bias	-50 to -25 Pa	2	-2.5 to + 1.5	10	-13 to -6
Depressurize with Bias	-75 to -50 Pa	1.4	-2 to + 0.5	5.3	-7 to -3
Both Directions with Bias	∇75 to ∇50 Pa	1.1	-1.1 to + 1.5	4.9	-6 to -3
Both Directions without Bias	∇75 to ∇50 Pa	1.5	-1.8 to + 1.5	3	-6 to -1
Both Directions without Bias	∇50 to ∇25 Pa	1.5	-1.8 to + 1.9	4.9	-8 to -3

Direction	Pressure range	CFM75 in 2 to 4 mph wind, deviation %	CFM75 in 10 to 15 mph wind, deviation %
Depressurize	-60 to -12.5 Pa	2%	17%
	-50 to -25 Pa	2%	10%, 30%, 16%
	-75 to -50 Pa	1.4%	5.3%, 9%
Pressurize	+50 to +25 Pa	2%	9%, 15%
	+75 to +50 Pa	1%	3%, 6%, 5%
Both ways	∇50 to ∇25 Pa		11%, 10%
	∇75 to ∇50 Pa	1.1%	4%, 3%, 4.9%, 3%

## 7.2 Observations

1. Under windy conditions, the classic ASTM test procedure (measuring the before and after bias pressure and only testing in one direction from 60 to 12.5 Pa) produced the most unacceptable results. Variations in flow readings from 1 minute to the next, even with time averaging in place, varied as much as 25 percent for one reading.
2. If testing was to be completed in only one direction, reasonable results could be achieved by measuring the before and after bias pressures and testing at higher test pressures, from 75 to 50 Pa.
3. Testing in both directions and averaging the results always yielded results with less deviation than only testing in one direction.
4. Bias pressures taken with 30 second averaging would vary markedly from one sample to the next leading us to conclude that an even more rigorous method was required, such as 12 readings taken over at least 120 seconds.



## 7.3 Conclusions

### 7.3.1 General

1. The classic ASTM set of test points from 10 to 60 Pa was unacceptable under windy conditions.
2. The preferred test method is to test in both directions, from 50 to 75 Pa up to a maximum of 75 Pa. Allow for larger bias pressures by taking numerous readings to establish a test point over at least 10 seconds and then taking 12 test points in total. Then the door fan readings would be taken over a time period that is twice as long.
3. If testing in both directions is not possible due to the equipment characteristics, then pressurize only readings would be acceptable, but the test must be from 50 to 75 Pa.

ASTM encourages testing under ideal weather conditions of less than 4 mph wind and a temperature range of 41 to 95 F to keep bias pressures to a minimum, but these ideal conditions are seldom experienced in tall buildings due to their height or their specific environment, increasing the likelihood that the test will be canceled. A more robust procedure is required to handle bias pressures that allow buildings to be tested in virtually any weather conditions short of storms. ASTM makes small corrections for temperature, barometric pressure, and elevation that do not help much with overall accuracy, but give the impression of accuracy. The overriding source of accuracy and repeatability is due to bias pressure.

### 7.3.2 Testing in Both Directions

The preferred way to eliminate bias pressure problems is to test the building in both the pressurization and depressurization directions and average the results. Bias pressure errors are non linear and cannot be properly allowed for by merely subtracting the bias from the reading. Testing in both directions cancels out these errors very effectively thus tolerating much larger bias pressures, up to 30 percent of the lowest test pressure.

### 7.3.3 Allowance to Test in One Direction Only

Making allowances for testing in only one direction acknowledges that very large buildings may require truck- or trailer-mounted blower equipment or that they may require the use of the building HVAC system that logistically will not easily allow testing in both positive and negative directions. Because bias pressures will have a greater impact on single-direction tests, the maximum allowable bias pressure under these circumstances has been reduced to 10 percent of the lowest test pressure of 50 Pa in this case. On the other hand, the upper test pressure achieved must be at least 75 Pa. At these pressures, the bias pressure is somewhat masked by the higher test pressure and extrapolation is no longer an issue. Because buildings often leak more in one direction versus the other, testing in only one direction must be considered less accurate than testing in both directions.

The bias pressure in a 40-ft high building where the temperature was 0 °F outside and 68 °F inside and negligible wind for example, would be 10.5 Pa. This bias would typically be broken up into say +5 at the top and -5.5 at the bottom of the building. If bias pressure was a problem during the test the indoor temperature could be brought closer to the outdoor temperature by running door fan for about 5 minutes, which would be sufficient time to replace most of the indoor air with outdoor air, and thereby reduce the bias pressure somewhat.

### 7.3.4 Summary of Deviations from the ASTM Standard

All pressure tests shall comply with the requirements of ASTM E 779-03 with exceptions indicated in the table below.

ASTM E 779-03	U.S. Army CE Protocol	Reason for change
6.2.2 “accuracy of $\nabla$ 5% of measured pressure.”	The gage must have an accuracy of $\pm 1$ % or 0.5 Pa, whichever is greater and must have had its calibration checked against a NIST traceable standard within 2 years.	Modern gauges are typically much more accurate than the analog gauges that ASTM was written to accommodate and there is every reason to take advantage of the increased accuracy.
8.4 “If the product of the absolute value of the indoor/outdoor air temperature difference multiplied by the building height, gives a result greater than 1180 ft °F, do not perform the test, because the pressure difference induced by the stack effect is too large to allow accurate interpretation of the results.”	The protocol allows for a wider range of heights and temperatures by limiting bias pressure to 30% of the lowest test pressure when testing both ways and 10% when testing one way.	The ASTM requirement of 1180 ft °F would only permit four-story buildings (48 ft high) to be tested when the indoor/outdoor temperature difference was less than 25 °F, which would be impractical. The Protocol is both more stringent and more flexible due to the higher minimum test pressures that tolerate higher bias pressures. The ASTM requirement of 1180 ft °F produces a stack of about 4.2 Pa, which is 42% of the lowest 10 Pa test point whereas the Protocol permits a maximum bias pressure (wind and stack) of 30% of the lowest test pressure when testing both ways and 10% when testing one way. This results in a maximum allowable bias pressure of 7.5 to 15 Pa and 5 Pa for the Protocol.
8.5 “Preferred test conditions are wind speed of 0 to 2 m/s [0 to 4 mph] and an outside temperature from 5 to 35° C. [41 to 95° F].”	Preferred test condition superseded by requirement to keep bias pressure within limits.	The ASTM preference of wind speeds less than 4 mph and outside temperature range from 41 to 95°F would mean that the rescheduling of test would be required in about 50% of all cases. This is impractical and the more robust procedure in the protocol takes care of wind and temperature differences by accurately measuring bias pressures over a period of time and then requiring that the air leakage measurements are made over the same time period.
8.10 “.... Pressure difference shall be from 10 to 60 Pa...at least five data points...”	“Adjust the door fan speed to establish a series of 12 equally spaced Building Pressure Test Points where each Test Point is an accumulation of at least 10 readings taken over a time period that is at least double the time taken to collect Bias Pressure Test Points”	Because results are required at 75 Pa, taking data up to and including this point of interest vastly increases accuracy and repeatability. The Protocol is far more stringent than ASTM yet with modern equipment takes less effort than the old manual way of taking readings.
8.13 “For each test, collect data for both pressurization and de-pressurization.”	Testing in both directions is preferred.  Testing from $\nabla$ 75 Pa to $\nabla$ 50 Pa is acceptable because buildings tend to leak slightly more under positive pressure.	Testing in both directions results in simpler and more repeatable tests.  Tests with trailer mounted fans or the building's HVAC systems may only be possible in one direction and the protocol allows for then to be used.

## 8 Glossary and Acronyms

### 8.1 Glossary and Acronyms

Term	Definition
air tightness	Pertains to how free air leakage may be in an enclosure. In actual fact, measurements can only be made of air leakage rates not air tightness itself so one could think of these terms as being opposites. In spite of the confusion, the terms are used interchangeably.
air barrier	The air barrier defines the surface that separates the inside air from the outside air. Generally this should be an inner barrier such as sheet rock, which prevents air from moving through the insulation. The air barrier should be in contact with the insulation. The air barrier should not be outside the insulation.
air leakage	Pertains to how leaky an enclosure may be. See Air tightness.
average bias pressure	A series of 12 test pressure points that are averaged to produce one value.
baseline pressure	A method of reading or determining the background or bias pressure by having a digital gauge accumulate readings over an adjustable time period .
background pressure	See bias pressure.
bias pressure	This is defined as the pressure that exists when the enclosure has been prepared for the test, but before the fan pressurization system is activated. There is always some bias pressure due to stack, wind, flues and active HVAC systems. There are two components of bias pressure. A fixed static offset (usually due to stack or HVAC) and a fluctuating pressure (usually due to wind or elevator operation). In ASTM bias pressures are called “zero flow pressures” for the pressure measured with zero flow going through the door fan.
blower door	Commonly used term for a door fan, which means a calibrated fan capable of measuring air-flow. The door fan is temporarily mounted in doorway, hence the adjective “door” prefixing “fan.” Door fans do not use blowers. A blower more accurately describes an air moving device of the squirrel cage variety; hence the adjective “blower” does not normally apply to the bulk of door fans since they do not use a blower.
building envelope	See enclosure.
building enclosure	The boundary or air barrier separating the interior conditioned volume of a building from the outside environment. See enclosure.
CFM @ 50 Pa or CFM50	CFM @ 50 Pa is the flow rate, in CFM, required to depressurize the building to – 50 Pa.
ACH @ 50 Pa	ACH @ 50 Pa is CFM50 x 60 minutes/ hour, divided by the house volume. It is also referred to as “Air Changes at 50 Pa” or “ACH50.”
conditioned volumes	Any space maintained above 50 °F in winter and below 80 °F in summer.
door fan	A calibrated fan capable of measuring air-flow of that is temporarily mounted in a doorway. Door fan is more linguistically correct than the common term “blower door.” Since it is not a “door,” but rather a “fan” and since it does not use a “blower.” a more correct term is door fan.
digital gauge	For the purpose of this Protocol, it is a gauge with an electronic pressure sensor and digital display that is capable of reading in tenths of a Pascal.
Effective Leakage Area	EfLA at 4 Pa using 1.0 discharge coefficient which is not to be confused with EqLA which is normally 50% larger

Term	Definition
enclosure	The surface bounding a volume, which is connected to outdoors directly. For example an apartment whose only access to outdoors was through a doorway that leads directly outdoors. Or, a building with a series of apartments or offices whose only access to the outdoors is through a common hallway then the enclosure would be the volume that bounds all of the apartments or offices.
Equivalent Leakage Area	EqLA, usually taken at 10 Pa using 0.61 discharge coefficient, but for the purposes of this document, it is taken at 75 Pa.
envelope	See enclosure.
exterior enclosure	See enclosure. The addition of the word exterior emphasizes the fact that we are primarily dealing with enclosures that face the outdoors. The boundary or air barrier separating the interior conditioned volume of a building from the outside environment. This represents the enclosure that faces the “exterior,” but is actually measured from inside the building.
fan-pressurization method	Term is used in the ASTM standard and does a decent job of describing what a door fan test is except that it may delude us into thinking that depressurization is not an option.
sq ft	This refers to “square feet.” In this document it usually refers to the surface area of the envelope, which is also called “the enclosure.”
micromanometer	A digital gauge that is capable of reading in tenths of a Pascal.
outdoors	Outside the building in the area around the building.
readings	Discrete pressure or flow values read from the gauge(s). Typically five or six readings or samples are taken every second when using a digital micromanometer, which may not be apparent since the display is updated every second.
test points	Consists of a group of readings taken over a 10–30 second time period, which are typically averaged to produce one test point that could be used as one of the multiple points in a curve fit or overall average.
time averaging	Refers to the digital gauge display that must have an adjustable averaging from 1 second to 1 minute for the purpose of averaging fluctuating pressure signals. Averaging can be block averages that will update for the length of the average or rolling (moving) averages that will update continuously by displaying the average over the past time period.
single zone	A space in which the pressure difference between any two places, differ by no more than 5% of the inside to outside pressure difference.
static pressure	See bias pressure.
zero flow pressure	ASTM terminology for bias pressures.

## 8.2 Acronyms and Abbreviations

Term	Spellout
ACH	air changes per hour
AOR	Architect of Record
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
ATTMA	Air Tightness Testing and Measurement Association
CD	Compact Disk
CE	

Term	Spellout
CERL	Construction Engineering Research Laboratory
CFM	cubic feet per minute
CGSB	Canadian General Standards Board
CI	Confidence Interval
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EfLA	Effective Leakage Area
EqLA	Equivalent Leakage Area
ERDC	Engineer Research and Development Center
ERDC-CERL	Engineer Research and Development Center, Construction Engineering Research Laboratory
HVAC	heating, ventilating, and air-conditioning
IR	infrared
ISO	International Organization for Standardization
ITC	Infrared Training Center
NIST	National Institute of Standards and Technology
STP	standard temperature and pressure conditions of 14.696 psi (101.325 KPa) and 68F (20°C).
UEPH	Unaccompanied Enlisted Personnel Housing
UK	United Kingdom
U.S.	United States
USACE	U.S. Army Corps of Engineers

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX SS

### SECTION 01 33 29 LEED DOCUMENTATION

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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## SECTION 01 33 29

## LEED(TM) DOCUMENTATION

02/10

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001 (2000) Principles and Criteria for Forest Stewardship

## U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED 2009)

LEED Reference Guide (2009) LEED Reference Guide for Green Building and Construction

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

## SD-01 Preconstruction Submittals

LEED Implementation Plan[; G][; G, [\_\_\_\_\_]]

## SD-11 Closeout Submittals

LEED Documentation Notebook[; G][; G, [\_\_\_\_\_]]

## 1.3 DESCRIPTION

This project has been designed for, and shall be developed for a sustainable rating of [certified] [silver] [gold] [platinum] in accordance with LEED Version [\_\_\_\_\_]. Table 1 (see paragraph Table) identifies the LEED credit items that are designed into or otherwise required for this project. No variations or substitutions to the LEED credits identified for this contract shall be allowed without written consent from the Contracting Officer. Should there be a case where there is any problem meeting the full requirements of a LEED credit identified for this project in Table 1, the Contractor must bring this to the attention of the Contracting Officer immediately.



### 1.3.1 Credit Validation

[This project will not be registered with USGBC for validation of credits earned. Validation of credits earned will be accomplished by the Government. Content of all construction documentation must be in accordance with the LEED Reference Guide requirements for supporting data required and must use LEED Letter Templates, which shall be [provided by the Government][obtained by Contractor at Contractor's expense]. Design phase LEED documentation will be provided separately by others.]

[This project will be registered with USGBC for validation of credits earned. Contractor is not responsible for registering the project with USGBC or for paying project registration fees to USGBC. Format and content of all construction documentation must be in accordance with the LEED Reference Guide requirements for supporting data required in event of USGBC audit of the particular credit. Contractor is required to coordinate through the Contracting Officer with Government's [LEED consultant][Administrative Assistant] on assuring assembled data is acceptable to USGBC and responding to USGBC requests for additional construction data in the course of seeking project certification. Design documentation will be provided by others.]

### 1.3.2 Contractor Responsibilities

Some LEED credits are inherent in the design provided and require no further submittal or documentation. For these credits, the Contractor notify the Contracting Officer in advance of selection of any specified material or use of any permissible construction methods that may result in a deviation from the LEED designer intent. Some LEED credits involve material selection and are generally identified within the technical sections with the notation "LEED," though not specifically identified in all occurrences. Some LEED credits are dependent on construction practices.

All LEED credits identified in Table 1 not inherent in the design provided shall be documented by the Contractor. Table 1 provides a general summary of applicable credits. Detailed submittal requirements are contained in the LEED Reference Guide and in the technical sections.

In all cases where a material, product, or execution requirement is identified by "LEED" in the contract documents, additional data or certificates shall be submitted with the individual component or process validating the material or component to the respective LEED credit item. These additional data or certificates shall be separable from the other submitted data and a copy shall be included in the LEED Documentation Notebook in addition to the distribution indicated in the submittal register.

### 1.4 LEED IMPLEMENTATION PLAN

LEED Implementation Plan shall be submitted within [30][\_\_\_\_\_] days after notice to proceed. The plan, when completed, shall provide a detailed description of all activities that relate to accomplishing project LEED requirements, including construction practices, procurement practices, and proposed submittals and documentation for each LEED credit. Plan shall also include the following:

- a. Name of individual[s] on the Contractor's staff responsible for ensuring LEED credits and prerequisites are earned and responsible for assembling documentation. A responsible [individual] [LEED Accredited Professional] shall be identified.
- b. Copy of [proposed] contract with Commissioning Agent.
- c. Templates to be used for tracking LEED credits. Listing of documents to be provided for each credit and schedule for their inclusion in LEED Documentation Notebook.
- d. List of all plans required in the technical sections for LEED credit. Proposed submittal date for each plan. These shall be added to the LEED Implementation Plan as they are completed.
- e. Implementation plan for cumulative materials credits, which shall use applicable template with proposed materials, associated estimated costs, and details necessary for LEED Calculations added in order to determine if the listed materials can be expected to achieve the project goal. Submit cumulative materials implementation plans before materials purchasing begins.

## 1.5 LEED DOCUMENTATION NOTEBOOK

The Contractor shall prepare a comprehensive notebook documenting compliance for each LEED credit identified in Table 1. LEED Documentation Notebook shall be formatted to match LEED numbering system and tabbed for each credit and prerequisite. LEED documentation in notebook shall contain up to date information through the previous[week's][ month's] work, and at least one set shall be available on the jobsite at all times. [The Notebook may be maintained and available for reference electronically if preferred.] Completed pages shall be prevented from being altered. If the Contractor fails to maintain the LEED Documentation Notebook as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the Notebook. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of the Notebook. The original, [one copy,] [[\_\_\_\_] copies,] and an electronic version on CD of the notebook shall be submitted at project closeout.

### 1.5.1 Content

Notebook shall include Table 1, applicable product data for material selection, final calculations, certifications for construction practices, procurement data, cumulative calculations and other items as identified in the approved LEED Implementation Plan. Notebook must contain all required data to support full compliance with the indicated LEED credit. LEED credits that are inherent to the design will be documented by the designer of record.

### 1.5.2 LEED Calculations

Calculations showing compliance with a required LEED credit identified in Table 1 or within the LEED Implementation Plan. Calculations shall be current and available for monthly review. Final calculations shall be included in the LEED Documentation Notebook under the appropriate tab.

### 1.5.3 Submittals

All "G" designated submittals required for inclusion in the LEED Documentation Notebook shall be separable from other submitted data and shall be included in the LEED Documentation Notebook in addition to the distribution indicated on the submittal register.

## 1.6 REQUIREMENTS

LEED credits as identified in Table 1 shall be incorporated and documented as required by the Contract documents and in full compliance with the LEED Reference Guide. LEED credits not identified elsewhere in the Contract documents and those requiring further instruction are specified below. Refer to the LEED Reference Guide for further definitions and requirements.

### 1.6.1 Materials and Resources Credit 3, Materials Reuse

Project goal is that a minimum of [5][10][\_\_\_\_] percent (by dollar value) of materials and products for the project are salvaged, refurbished, or reused materials and products. The following salvaged, refurbished, and reused materials are specified: [\_\_\_\_]. Contractor shall track cumulative calculations for this credit. [For this credit, performance is measured [for the entire project] [separately for each facility or facility type indicated to achieve this credit in Table 1].]

### 1.6.2 Materials and Resources Credit 4, Recycled Content

[Notwithstanding the requirements of Section 01 62 35 RECYCLED/RECOVERED MATERIALS, Contractor shall select materials so that the sum of post-consumer recycled content value plus one-half of post-industrial recycled content value constitutes at least [10][20][\_\_\_\_] percent of the total materials cost for the project. EPA Comprehensive Procurement Guidelines has a [supplier database](#). California Integrated Waste Management Board (CIWMB) Recycled Content Directory also contains product and supplier data at [www.ciwmb.ca.gov/rcp](http://www.ciwmb.ca.gov/rcp).]

[The following recycled content materials are specified so that the sum of post-consumer recycled content value plus one-half of post-industrial recycled content value constitutes at least [10][20][\_\_\_\_] percent of the total materials cost for the project: [\_\_\_\_].]

#### 1.6.2.1 Calculations

LEED Letter Template forms[ provided by Government] shall be used for tracking and documentation. Recycled content value of project materials shall be determined by the method described in the LEED Reference Guide. [For this credit, performance is measured [for the entire project] [separately for each facility/facility type indicated to achieve this credit in Table 1].]

#### 1.6.2.2 Substitutions

In the case of conflict between this requirement and individual technical section requirements, Contractor may submit for Government approval proposed alternative products or systems that provide equivalent performance and appearance and have greater contribution to project recycled content requirements. All such proposed substitutions shall be submitted with the

LEED Implementation Plan accompanied by product data that demonstrates equivalence.

### 1.6.3 Materials and Resources Credit 5, Regional Materials

[Contractor shall select materials so that a minimum of [10][20][\_\_\_\_\_] percent (by dollar value) of materials and products for the project are extracted, harvested, or recovered, as well as manufactured, regionally within a 500 mile radius of the project site.]

[The following technical sections include regional material requirements so that, if available, a minimum of [10][20][\_\_\_\_\_] percent (by dollar value) of materials and products for the project are extracted, harvested, or recovered, as well as manufactured, regionally within a 500 mile radius of the project site: [\_\_\_\_\_.]

#### 1.6.3.1 Calculations

LEED Letter Template forms[ provided by the Government] shall be used for tracking and documentation. Amount of regional project materials shall be determined by the method described in the LEED Reference Guide. [For this credit, performance is measured[ for the entire project][ separately for each facility/facility type indicated to achieve this credit and Table 1].]

### 1.6.4 Materials and Resources Credit 6, Rapidly Renewable Materials

A minimum of [2.5][\_\_\_\_\_] percent (by dollar value) of materials and products for the project shall be rapidly renewable. Rapidly renewable materials are made from plants with a 10-year or shorter harvest cycle. The following rapidly renewable materials are specified: [\_\_\_\_\_. Contractor shall track cumulative calculations for this credit. [For this credit, performance is measured [for the entire project] [separately for each facility/facility type indicated to achieve this credit in Table 1].]

### 1.6.5 Materials and Resources Credit 7, Certified Wood

[Contractor shall select materials so that a minimum of [50][\_\_\_\_\_] percent (by dollar value) of permanently installed wood-based materials and products for the project are certified in accordance with FSC STD 01 001.]

[The following certified wood materials are specified so that a minimum of [50][\_\_\_\_\_] percent (by dollar value) of wood-based materials and products for the project are certified in accordance with FSC STD 01 001: [\_\_\_\_\_.]

#### 1.6.5.1 Calculations

LEED Letter Template forms[ provided by the Government] shall be used for tracking and documentation. Amount of FSC-certified project materials shall be determined by the method described in the LEED Reference Guide. [For this credit, performance is measured [for the entire project] [separately for each facility/facility type indicated to achieve this credit in Table 1].]

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

### 3.1 COORDINATION MEETINGS

There will be three onsite coordination meetings. The first will be a preconstruction meeting to review the LEED Implementation Plan. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in SectionC:\SISGML\JOBS\LANGHANG\prntdata\ .doc 01 45 00.00 10 QUALITY CONTROL. The second will be a pre-closeout meeting to review LEED Documentation Notebook for completeness and identify any outstanding issues relating to final score and documentation requirements. The third is a closeout meeting to review the final LEED Documentation Notebook. All meetings shall be attended by Contractor's designated individual responsible for LEED documentation, Government representative and Installation representative. At closeout meeting a final score for the project will be determined based on review of project performance and documentation. Contractor shall make a set of contract drawings and specifications available for review at each meeting as well as an updated LEED Documentation Notebook.

### 3.2 TABLE

LEED credits as identified in Table 1 below are contract requirements and shall be incorporated in full compliance with the LEED Reference Guide.

-- End of Section --

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## APPENDIX TT

### SECTION 01 74 19.00 50 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

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## SECTION 01 74 19.00 50

## CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

02/03

## PART 1 GENERAL

## 1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy the Contractor shall: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

## 1.2 MANAGEMENT

The Contractor shall take a pro-active, responsible role in the management of construction and demolition waste and require all subContractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling shall accrue to the Contractor. Firms and facilities used for recycling, reuse, and disposal shall be appropriately permitted for the intended use to the extent required by federal, state, and local regulations.

## 1.3 CONSTRUCTION &amp; DEMOLITION (C&amp;D) WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after [contract award][notice to proceed] and prior to initiating any site preparation work. At a minimum, the plan shall include the contractor's plan(s) for a minimum fifty percent (50%) diversion rate or justification for less than a fifty percent (50%) rate due to time and/or cost constraints as identified below. The plan shall include the following:

- a. Name of individuals on the Contractor's staff responsible for waste prevention and management.
- b. Actions that will be taken to reduce solid waste generation.
- c. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas and equipment to be used for processing, sorting, and temporary storage of wastes.



- d. Characterization, including estimated types and quantities, of the waste to be generated.
- e. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.
- f. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity.
- g. List of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified.
- h. Identification of materials that cannot be recycled/reused with an explanation or justification.
- i. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

The contractor shall notify the Contracting Officer if diversion activities will cause the project duration time to be exceeded. Along with the notification, the contractor shall provide the highest diversion rate that can be obtained based on the project schedule. If it is determined by the Government that the project is mission-critical, the diversion rate may be amended.

If the cost of achieving the fifty percent (50%) minimum diversion rate is significantly greater than the cost of conventional demolition methods and the risk can be attributed directly to meeting the minimum diversion rate, the contractor shall immediately notify the Contracting Officer for a determination on whether a lower diversion rate is acceptable. If the Contracting Officer determines that a lower diversion rate is acceptable, the rate may be amended to the highest obtainable rate that can be met as agreed upon by all parties.

#### 1.4 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction. Throughout the duration of the contract, contractor shall maintain and make available to the Contracting Officer, records, to include all weight tickets, documenting the quantity of waste generated, the quantity of waste diverted from a landfill or incineration and the quantity of waste disposed by landfill or incineration. Upon contract completion, the contractor shall submit a copy of all records with a statement certifying that at least fifty percent (50%) of C&D waste has been diverted from landfill disposal to the Installation EMO.

## 1.5 COLLECTION

The necessary containers, bins and storage areas to facilitate effective waste management shall be provided and shall be clearly and appropriately identified. Recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials and separated by one of the following methods:

### 1.5.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted into appropriately marked separate containers and then transported to the respective recycling facility for further processing.

### 1.5.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

### 1.5.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

## 1.6 DISPOSAL

Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

### 1.6.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered. Salvaged materials, other than those specified in other sections to be salvaged and reinstalled, shall not be used in this project.

### 1.6.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible.

### 1.6.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

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## APPENDIX UU

### Operation and Maintenance Data Specification Section

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## F-22 Add/Alter Hangar Bay LO/CR Facility

## SECTION 01 78 23.00 50

## OPERATION AND MAINTENANCE DATA

07/06

## PART 1 GENERAL

## 1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors shall compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor shall compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00.00 50 SUBMITTAL PROCEDURES.

## 1.1.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

## 1.1.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections shall use Data Package [3] [4] [5]. Commissioned items with a Data Package 1 or 2 requirement shall use instead Data Package [3] [4] [5].

## 1.1.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

## 1.1.4 Review and Approval

The [Contractor's Commissioning Authority (CA)] [Government's Commissioning Authority (CA)] shall review the commissioned systems and equipment submittals for completeness and applicability. The [CA] [Government] shall verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local

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environmental impacts. [The CA shall communicate deficiencies to the Contracting Officer. Upon a successful review of the corrections, the CA shall recommend approval and acceptance of these O&M manuals to the Contracting Officer.] This work shall be in addition to the normal review procedures for O&M data.

## [1.1.5 O&amp;M Database

Develop a database from the O&M manuals that contains the information required to start a preventative maintenance program.

## ]1.2 TYPES OF INFORMATION REQUIRED IN O&amp;M DATA PACKAGES

## 1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

## 1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

## 1.2.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

## 1.2.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

## 1.2.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

## 1.2.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

## 1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

## 1.2.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each

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product, component or system. Describe conditions under which the item equipment should not be allowed to run.

## 1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

## 1.2.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

- a. A table showing recommended lubricants for specific temperature ranges and applications.
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- c. A Lubrication Schedule showing service interval frequency.

## 1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

## 1.2.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E 1971.

## 1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

## 1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

## 1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a



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complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

## 1.2.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

## 1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

## 1.2.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

## 1.2.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

## 1.2.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

## 1.2.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

## 1.2.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

## 1.2.5.3 O&amp;M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

## 1.2.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to

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use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

## 1.2.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

## 1.2.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

## 1.2.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

## 1.2.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

## 1.2.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

## 1.3 TYPES OF INFORMATION REQUIRED IN CONTROLS O&amp;M DATA PACKAGES

Include Data Package 5 and the following for control systems:

- a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

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- b. Full as-built sequence of operations.
- c. Copies of all checkout tests and calibrations performed by the Contractor (not Cx tests).
- [ d. Full points list. A listing of rooms shall be provided with the following information for each room:
  - (1) Floor
  - (2) Room number
  - (3) Room name
  - (4) Air handler unit ID
  - (5) Reference drawing number
  - (6) Air terminal unit tag ID
  - (7) Heating and/or cooling valve tag ID
  - (8) Minimum cfm
  - (9) Maximum cfm]
- [ e. Full print out of all schedules and set points after testing and acceptance of the system.]
- [ f. Full as-built print out of software program.]
- [ g. Electronic copy on disk or CD of the entire program for this facility.]
- [ h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.]

## 1.4 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

## 1.4.1 Data Package 1

- a. Safety precautions
- b. Cleaning recommendations
- c. Maintenance and repair procedures
- d. Warranty information
- e. Contractor information
- f. Spare parts and supply list

## 1.4.2 Data Package 2

- a. Safety precautions

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- b. Normal operations
- c. Environmental conditions
- d. Lubrication data
- e. Preventive maintenance plan and schedule
- f. Cleaning recommendations
- g. Maintenance and repair procedures
- h. Removal and replacement instructions
- i. Spare parts and supply list
- j. Parts identification
- k. Warranty information
- l. Contractor information

## 1.4.3 Data Package 3

- a. Safety precautions
- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Environmental conditions
- g. Lubrication data
- h. Preventive maintenance plan and schedule
- i. Cleaning recommendations
- j. Troubleshooting guides and diagnostic techniques
- k. Wiring diagrams and control diagrams
- l. Maintenance and repair procedures
- m. Removal and replacement instructions
- n. Spare parts and supply list
- o. Product submittal data
- p. O&M submittal data
- q. Parts identification

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- r. Warranty information
- s. Testing equipment and special tool information
- t. Testing and performance data
- u. Contractor information

## 1.4.4 Data Package 4

- a. Safety precautions
- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Operator service requirements
- g. Environmental conditions
- h. Lubrication data
- i. Preventive maintenance plan and schedule
- j. Cleaning recommendations
- k. Troubleshooting guides and diagnostic techniques
- l. Wiring diagrams and control diagrams
- m. Maintenance and repair procedures
- n. Removal and replacement instructions
- o. Spare parts and supply list
- p. Corrective maintenance man-hours
- q. Product submittal data
- r. O&M submittal data
- s. Parts identification
- t. Warranty information
- u. Personnel training requirements
- v. Testing equipment and special tool information
- w. Testing and performance data
- x. Contractor information

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## 1.4.5 Data Package 5

- a. Safety precautions
- b. Operator prestart
- c. Start-up, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Environmental conditions
- f. Preventive maintenance plan and schedule
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring and control diagrams
- i. Maintenance and repair procedures
- j. Removal and replacement instructions
- k. Spare parts and supply list
- l. Product submittal data
- m. Manufacturer's instructions
- n. O&M submittal data
- o. Parts identification
- p. Testing equipment and special tool information
- q. Warranty information
- r. Testing and performance data
- s. Contractor information

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

Not used.

-- End of Section --

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

## APPENDIX VV

### AIR PERMIT

Add/Alter Hangar Bay  
LO/CR Facility  
Langley AFB, Virginia

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# COMMONWEALTH of VIRGINIA

## DEPARTMENT OF ENVIRONMENTAL QUALITY

### TIDEWATER REGIONAL OFFICE

5636 Southern Boulevard, Virginia Beach, Virginia 23462

(757) 518-2000 Fax (757) 518-2009

[www.deq.virginia.gov](http://www.deq.virginia.gov)

Doug Domenech  
Secretary of Natural Resources

David K. Paylor  
Director

Francis L. Daniel  
Regional Director

April 6, 2010

Ms. Brenda W. Cook, DAFC  
Deputy Base Civil Engineer  
633 CES/CD  
37 Sweeney Boulevard  
Langley AFB, Virginia 23665-2107

Location: Hampton  
**Registration No.: 60059**  
AFS Id. No.: 51-650-00007

Dear Ms. Cook:

Attached is a minor amendment to your state operating permit to operate Langley Air Force Base Joint Base Langley - Eustis in accordance with the provisions of the Virginia Regulations for the Control and Abatement of Air Pollution. This permit supersedes your permit dated July 31, 2009.

This permit contains legally enforceable conditions. Failure to comply may result in a Notice of Violation and/or civil charges. Please read all permit conditions carefully.

In the course of evaluating the application and arriving at a final decision to approve the project, the Department of Environmental Quality (DEQ) deemed the application complete on March 17, 2010.

This permit approval to operate shall not relieve Langley Air Force Base of the responsibility to comply with all other local, state, and federal permit regulations.

The Board's Regulations as contained in Title 9 of the Virginia Administrative Code 5-170-200 provide that you may request a formal hearing from this case decision by filing a petition with the Board within 30 days after this case decision notice was mailed or delivered to you. 9 VAC 5-170-200 provides that you may request direct consideration of the decision by the Board if the Director of the DEQ made the decision. Please consult the relevant regulations for additional requirements for such requests.

Tuesday, July 13, 2010

April 6, 2010

Page 2

As provided by Rule 2A:2 of the Supreme Court of Virginia, you have 30 days from the date you actually received this permit or the date on which it was mailed to you, whichever occurred first, within which to initiate an appeal of this decision by filing a Notice of Appeal with:

David K. Paylor, Director  
Department of Environmental Quality  
P. O. Box 1105  
Richmond, VA 23218-1105


If this permit was delivered to you by mail, three days are added to the thirty-day period in which to file an appeal. Please refer to Part Two A of the Rules of the Supreme Court of Virginia for information on the required content of the Notice of Appeal and for additional requirements governing appeals from decisions of administrative agencies.

It has been determined that several emergency generator sets included in this permit are affected units under 40 CFR 60, New Source Performance Standards (NSPS), Subpart IIII, and therefore are subject to the owner/operator requirements of this NSPS. In summary, each unit is required to comply with certain federal emission standards and operating limitations over its useful life. The Department of Environmental Quality (DEQ) advises you to review the NSPS to ensure compliance with applicable emission and operational limitations. As the owner/operator you are also responsible for monitoring, notification, reporting, and recordkeeping requirements of the NSPS. Notifications shall be sent to U.S. EPA, Region III.

A copy of the results of performance test(s) required by 40 CFR 60, Subpart IIII shall be sent to:

Associate Director  
Office of Air Enforcement (3AP10)  
U.S. Environmental Protection Agency  
Region III  
1650 Arch Street  
Philadelphia, PA 19103-2029

If you have any questions concerning this permit, please contact Ms. Kelly R. Giles at 757-518-2155.

Sincerely,  
  
Jane A. Workman  
Air Permit Manager

jaw/krg/60059\_016\_10\_SOPminamend  
Attachments: Permit, Appendix A

cc: Director, OAPP (electronic file); Manager, Data Analysis (electronic file); Manager, Air Compliance

Tuesday, July 13, 2010



# COMMONWEALTH of VIRGINIA

## DEPARTMENT OF ENVIRONMENTAL QUALITY

### TIDEWATER REGIONAL OFFICE

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Secretary of Natural Resources

David K. Paylor  
Director

Francis L. Daniel  
Regional Director

### STATIONARY SOURCE PERMIT TO OPERATE This permit includes designated equipment subject to New Source Performance Standards (NSPS).

This permit supersedes replaces your permit dated July 31, 2009.

In compliance with the Federal Clean Air Act and the Commonwealth of Virginia Regulations for the Control and Abatement of Air Pollution,

Langley Air Force Base Joint Base Langley - Eustis  
633 CES/CD  
37 Sweeney Boulevard  
Hampton, Virginia 23665-2107  
**Registration No.: 60059**

is authorized to operate


an Air Force Base

located at

37 Sweeney Boulevard  
Hampton, Virginia 23665

in accordance with the Conditions of this permit.

Approved on: **April 6, 2010.**

  
\_\_\_\_\_  
Maria R. Nold  
Deputy Regional Director

Permit consists of 12 pages.  
Permit Conditions 1 to 35.

Tuesday, July 13, 2010

## INTRODUCTION

1. This permit approval is based on the permit application dated April 15, 2009, July 8, 1998, November 9, 2004, January 13, 2006, and June 23, 2008, including amendment information dated September 17, 1998, December 4, 1998, January 8, 1999, January 15, 1999, January 18, 1999, March 9, 1999, March 29, 1999, April 9, 1999, April 25, 2003, August 4, 2003, August 18, 2003, November 19, 2003, December 5, 2003, January 22, 2004, May 11, 2006, June 7, 2006, September 23, 2008, April 30, 2009, May 14, 2009, February 26, 2010 and March 17, 2010. Any changes in the permit application specifications or any existing facilities which alter the impact of the facility on air quality may require a permit. Failure to obtain such a permit prior to construction may result in enforcement action

Words or terms used in this permit shall have meanings as provided in 9 VAC 5-10-10 of the State Air Pollution Control Board Regulations for the Control and Abatement of Air Pollution. The regulatory reference or authority for each condition is listed in parentheses () after each condition.

Annual requirements to fulfill legal obligations to maintain current stationary source emissions data will necessitate a prompt response by the permittee to requests by the DEQ or the Board for information to include, as appropriate: process and production data; changes in control equipment; and operating schedules. Such requests for information from the DEQ will either be in writing or by personal contact.

The availability of information submitted to the DEQ or the Board will be governed by applicable provisions of the Freedom of Information Act, §§ 2.2-3700 through 2.2-3714 of the Code of Virginia, § 10.1-1314 (addressing information provided to the Board) of the Code of Virginia, and 9 VAC 5-170-60 of the State Air Pollution Control Board Regulations. Information provided to federal officials is subject to appropriate federal law and regulations governing confidentiality of such information.

## PROCESS REQUIREMENTS

2. **Equipment List** - Equipment at this facility consists of the following:

Equipment permitted prior to the date of this permit				
Reference No.	Equipment Description	Rated Capacity	Federal Requirements	Original Permit Date
E-23A	Caterpillar Model C32, U.S. EPA Tier 2 certified, Bldg. 23/2007 (ELRP)	1,502 HP/1,000 KW	NSPS, Subpart IIII	7/31/2009
E-23B	Caterpillar Model C32, U.S. EPA Tier 2 certified, Bldg. 23/2007 (ELRP)	1,502 HP/1,000 KW	NSPS, Subpart IIII	7/31/2009
Boilers	Multiple (5) natural gas-fired small boilers	< 10 MMBtu/hr	N/A	7/31/2009
Water Heaters	Multiple (3) natural gas-fired small water heaters	< 10 MMBtu/hr	N/A	7/31/2009
PAPCE - 1 PAPCE - 2	Two (2) - Portable air pollution control equipment (PAPCE) carts, Model AirVerter PP-500 series or DEQ approved equivalent HEPA air filtration units	1,900 cfm @ 7.5-in. WG suction capacity	N/A	10/30/2008
E-DCGS-A	Detroit Diesel, Model 1750DSEC, U.S. EPA Tier 2 certified, Bldg. DCGS/2008.	1780 KW	NSPS, Subpart IIII	8/14/2008

Equipment permitted prior to the date of this permit				
Reference No.	Equipment Description	Rated Capacity	Federal Requirements	Original Permit Date
E-DCGS-B	Detroit Diesel, Model 1750DSEC, U.S. EPA Tier 2 certified, Bldg. DCGS/2008.	1780 KW	NSPS, Subpart IIII	8/14/2008
E-DCGS-C	Detroit Diesel, Model 1750DSEC, U.S. EPA Tier 2 certified, Bldg. DCGS/2008.	1780 KW	NSPS, Subpart IIII	8/14/2008
E-10A	Kohler Power Systems model 1500REOZDB, Bldg. 10/2004 (ELRP)	2200 HP/1640 KW	N/A	1/26/2005
E-10B	Kohler Power Systems model 1500REOZDB, Bldg. 10/2004 (ELRP)	2200 HP/1640 KW	N/A	1/26/2005
E-888	Jet Engine Test Cell AF8045581-10/A/F37T-10, Bldg. 888-Hush House #1/year	400 engine tests, combined	N/A	2/4/2004
E-889	Jet Engine Test Cell AF804558/37T-10, Bldg. 889-Hush House #2/year	400 engine tests, combined	N/A	2/4/2004
Storage Tanks	Multiple above ground and/or underground fixed roof distillate oil tanks	Storage capacity of 107,050 gals.	N/A	7/26/1999
Storage tanks	Multiple above ground fixed roof and/or underground gasoline tanks	Storage capacity of 83,500 gals.	N/A	7/26/1999
Storage tanks	Multiple above ground fixed roof and/or underground JP-8 tanks	Storage capacity of 225,000 gals.	N/A	7/26/1999
Storage tanks	Six (6) above ground floating roof JP-8 tanks (I.D. Nos. 1016 – 1021)	Storage capacity of 3,510,000 gals.	N/A	7/26/1999
JP-8 – 1	JP-8 fuel loading rack	Maximum capacity of 60 million gals/yr.	N/A	7/26/1999
GAS – 1	Gasoline/diesel service station	N/A	N/A	7/26/1999
PAINT 01 to 08	Eight (8) designated paint spray booths, each with paint particulate filters	3,000 gals. of coatings total for all painting/yr	N/A	various
PAINT-1041	One paint spray area	3,000 gals. of coatings total for all painting/yr	N/A	7/26/1999
CC-1	Multiple cold solvent parts washers (non - halogenated solvents used)	4,000 gals. of fresh solvent/yr	N/A	7/26/1999
WW-1	Wood skills center (woodworking)	3.6 tons of sawdust	N/A	7/26/1999

Equipment Exempt from Permitting				
Reference No.	Equipment Description	Rated Capacity Brake HP / KW	Exemption Citation; 9 VAC 5-80-1320	Exemption Date
(See Appendix A)	Various Emergency Generators	< 1,125 kW each	5-80-1320 B.2.b	(See Appendix A)
E-1362C	Engine Fire Pump, Cummins N-855-F, Bldg. 1362/2002	160 – N/A	5-80-1320 B.2.b.	1/26/2005
E-1362D	Engine Fire Pump, Cummins N-855-F, Bldg. 1362/2002	160 – N/A	5-80-1320 B.2.b.	1/26/2005
E-348A	Engine Fire Pump, Cummins N-855-7, Bldg. 348/1980	240-N/A	5-80-1320 B.2.b.	7/26/1999
E-348B	Engine Fire Pump, Cummins N-855-7, Bldg. 348/1980	240-N/A	5-80-1320 B.2.b.	7/26/1999
E-348C	Engine Fire Pump, Cummins N-855-7, Bldg. 348/1980	240-N/A	5-80-1320 B.2.b.	7/26/1999
E-348D	Engine Fire Pump, Cummins N-855-7, Bldg. 348/1980	240-N/A	5-80-1320 B.2.b.	7/26/1999



Equipment Exempt from Permitting				
Reference No.	Equipment Description	Rated Capacity Brake HP / KW	Exemption Citation; 9 VAC 5-80-1320	Exemption Date
E-748A	Engine Fire Pump, Cummins N-855-F, Bldg. 748/1989	240-N/A	5-80-1320 B.2.b.	7/26/1999
E-748B	Engine Fire Pump, Cummins N-855-F, Bldg. 748/1996	240-N/A	5-80-1320 B.2.b.	7/26/1999
E-780A	Engine Fire Pump, Clark JU6HUF50, Bldg. 780/2003	210-N/A	5-80-1320 B.2.b.	2/4/2004
E-780B	Engine Fire Pump, Clark JU6HUF50, Bldg. 780/2003	210-N/A	5-80-1320 B.2.b.	2/4/2004
E-780C	Engine Fire Pump, Clark JU6HUF50, Bldg. 780/2003	210-N/A	5-80-1320 B.2.b.	2/4/2004
Boilers	Multiple gas-fired and/or oil-fired small boilers	< 10 MMBtu/hr	5-80-1320 B.1.c.	7/26/1999 8/14/2008
WE - 1/2	Two natural gas-fired wastewater evaporators: One - Sansco 500 model rated at 18.8 L/hr One - EMC model rated at 95.8 L/hr	< 10 MMBtu/hr	5-80-1320 B.1.c.	7/26/1999
---	Cooling Towers for HVAC system units	N/A	5-80-1320 D.1.	N/A
---	Gasoline Arresting Barrier Engines	4 - 64/47.7	5-80-1320 D.1.	N/A
---	Gasoline and Avgas Dispensing Facilities	N/A	5-80-1320 D.1.	N/A
---	Fire Fighter Training Activities	N/A	5-80-1320 D.1.	N/A

Specifications included in the permit under this Condition are for informational purposes only and do not form enforceable terms or conditions of the permit.

(9 VAC 5-80-850)

3. **Emergency Generator Inventory** – The permittee shall maintain a current inventory list for all emergency generators located at the facility. Appendix A shall contain all emergency generators on site and include the unit reference number, location, description, maximum rated capacity, date of installation and NSPS IIII applicability for each unit as well as designate which emergency generators are participating in the Emergency Load Response Program (ELRP). This inventory list shall be provided to the DEQ Tidewater Regional Office (Compliance/Inspection) on an annual basis, no later than February 15<sup>th</sup> of each year.  
(9 VAC 5-80-850)

4. **Emission Controls: Tanks** - Tank numbers 1016, 1017, 1018, 1019, 1020, and 1021 shall control volatile organic compound emissions with the following roof systems:

Tank 1016                      'floating roof with a dual seal.'  
Tanks 1017 to 1021        'floating roof with a single seal.'

(9 VAC 5-80-850 and 9 VAC 5-50-260)

5. **Emission Controls** - Particulate matter (PM) emissions from all paint spray booths shall be controlled by paint (particulate) filters. The filters shall be provided with adequate access for inspection and shall be in operation when the paint booths are operating.

(9 VAC 5-80-850 and 9 VAC 5-50-260)

6. **Emission Controls** - Particulate matter (PM) emissions from touch-up spray painting performed on aircraft serviced in the Aircraft Maintenance Unit (AMU) hangers shall be controlled by portable HEPA air filtration units (PAPCE), used in conjunction with shrouds to encapsulate the section of the aircraft where the sprayed paint is applied. Brush and/or roller applied touch-up painting on the aircraft in the AMU hangers shall not require the use of the PAPCE or shrouds. To ensure maximum performance of the portable air filtration units, the permittee shall follow the manufacturer's written requirements and/or recommendations for the operation and maintenance of the units. The PAPCE units shall be provided with adequate access for inspection and shall remain in operation whenever touch-up spray painting is performed on aircraft in the AMU hangers.  
(9 VAC 5-80-850)
7. **Emission Controls** - Volatile Organic Compound (VOC) emissions from spray painting activities conducted at the paint spray booths, designated paint areas, and the maintenance hangers shall be controlled by the use of high volume, low pressure spray guns, airless spray guns, portable aerosol spray gun applicators (Preval or equivalent), or the use of spray-can coating products.  
(9 VAC 5-80-850 and 9 VAC 5-50-260)
8. **VOC Work Practice Standards** - At all times the disposal of volatile organic compounds shall be accomplished by taking measures, to the extent practicable, consistent with air pollution control practices for minimizing emissions. Volatile organic compounds shall not be intentionally spilled, discarded in sewers which are not connected to a treatment plant, or stored in open containers, or handled in any other manner that would result in evaporation beyond that consistent with air pollution practices for minimizing emissions.  
(9 VAC 5-50-20 F and 9 VAC 5-80-850)
9. **Emission Standards** - Each cold cleaner parts-washer shall operate in compliance with 9 VAC 5 Chapter 40, Part II, Article 24, Emission standards for Solvent Metal Cleaning Operations, including, but not limited to the following:
  - a. Each parts-washer shall be provided with a cover operable with one hand, which should be closed whenever not handling parts in the cleaner;
  - b. External or internal drainage facilities should be provided to collect and return the solvent to a closed container or a solvent cleaning machine;
  - c. A permanent label, summarizing the operating procedures should be placed in a conspicuous location on or near the parts-washer;
  - d. If used, the solvent spray should be a solid, fluid stream (not a fine, atomized or shower-type spray) and at a pressure which does not cause excessive splashing;
  - e. Cleaned parts should drain for at least 15 seconds or until dripping ceases; and
  - f. Disposal of waste solvent shall be by reclamation (either by outside services or in-house), or by incineration.  
(9 VAC 5-80-850, 9 VAC 5-40-3280 C, and 9 VAC 5-40-3290 D)

10. **Emission Controls** - Particulate matter (PM) emissions from the woodworking area shall be controlled by a cyclone. The cyclone shall be provided with adequate access for inspection and shall be in operation when the woodworking area is operating.  
(9 VAC 5-80-850 and 9 VAC 5-40-2270 A)
11. **Emission Standards** - The woodworking shop (Building 224-Auto Shop) shall operate in compliance with 9 VAC 5 Chapter 40, Part II, Article 17, Emission Standards for Woodworking Operations. Compliance may be determined as stated in Conditions 10, 26, and 29 of this permit.  
(9 VAC 5-80-850 D)

### OPERATING LIMITATIONS

12. **Emergency Generator Operations** - The emergency generator sets located on the premises of the base facility shall be used only for providing electrical power during the interruption of service from the normal power supplier, periodic maintenance testing, and operational training. Only those units designated as participating in the Emergency Load Response Program (ELRP) may also operate during ELRP declared emergencies. Total operating hours for emergency generators shall not exceed **500 hours per year, each**, including periodic maintenance testing, operational training and the ELRP declared emergencies for those designated participating units, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months. Other than the ELRP, the designated participating emergency generators shall not operate voluntarily for the purpose of peak-shaving, demand response or as part of any other interruptible power supply arrangement with a power provider, other market participant or system operator, without first receiving permission from the DEQ. Each emergency generator shall be equipped with a non-resettable hour meter. Each hour meter shall be provided with adequate access for inspection and shall be in operation whenever the generator engine is operating.  
(9 VAC 5-80-850, 9 VAC 5-50-260, and 40 CFR 60.4209(a))
13. **Fuel Throughput** - The combined operation of all natural gas-fuel burning equipment shall consume no more than  $600 \times 10^6$  cubic feet of natural gas per year, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months.  
(9 VAC 5-80-850)
14. **Fuel Throughput** - The annual throughput of gasoline for the gasoline storage tanks shall not exceed 400,000 gallons per year, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months.  
(9 VAC 5-80-850)



15. **Fuel Throughput** - The annual throughput of JP-8 jet fuel for the JP-8 storage tanks (both above ground and underground) shall not exceed 60,000,000 gallons of JP-8 jet fuel per year, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months.  
(9 VAC 5-80-850)
16. **Throughput** - The annual throughput of coating media, as applied, for all paint spray booths and designated paint areas (including AMU hangers) shall not exceed 3,000 gallons per year, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months.  
(9 VAC 5-80-850)
17. **Throughput** - The annual throughput of solvents used in all cold solvent parts washers shall not exceed 4,000 gallons per year, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months.  
(9 VAC 5-80-850)
18. **Fuel Throughput** - The combined operation of all diesel-powered emergency generator sets and diesel-powered fire pumps shall consume no more than 90,000 gallons of diesel fuel per year, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months.  
(9 VAC 5-80-850)
19. **Fuel Throughput** - The combined operation of all distillate oil-fuel burning equipment, except for the diesel-powered emergency generator sets and diesel-powered fire pumps, shall consume no more than 35,000 gallons of distillate oil per year, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months.  
(9 VAC 5-80-850)
20. **Throughput** - The annual throughput of sawdust material from the wood skills center (woodworking area WW-1) entering the cyclone shall not exceed 3.6 tons per year, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months.  
(9 VAC 5-80-850)
21. **Jet Engine Testing Throughput** - The jet engine test cells shall not exceed 400 dismantled jet engine tests per year, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months.  
(9 VAC 5-80-850)

## **EMISSION LIMITS**

22. **Emission Limits for Painting** - Emissions from the painting operations conducted at all paint spray booths and designated paint areas (including AMU hangers), combined, shall not exceed:

11.0 tons per year of Volatile Organic Compounds

These emissions are derived from the estimated overall emission contribution from operating limits. Exceedance of the operating limits may be considered credible evidence of the exceedance of emission limits. Compliance with these emission limits may be determined as stated in Conditions 7, 8, 16, and 28 of this permit.

(9 VAC 5-80-850 and 9 VAC 5-50-260)

23. **Facility wide Emission Limits** - Total emissions from all emission units at the facility shall not exceed the limits specified below:

Particulate Matter (PM/PM-10)	16.0 tons/yr
Sulfur Dioxide	23.4 tons/yr
Nitrogen Oxides (as NO <sub>2</sub> )	98.0 tons/yr
Carbon Monoxide	69.4 tons/yr
Volatile Organic Compounds	32.9 tons/yr
Hazardous Air Pollutants:	
Single Highest HAP limit	5.0 tons/yr
Total HAPs limit (Base-wide)	16.0 tons/yr

These emissions are derived from the estimated overall emission contribution from operating limits. Exceedance of the operating limits may be considered credible evidence of the exceedance of emission limits. Compliance with these emission limits may be determined as stated in Conditions 3 - 21, and 24 - 28 of this permit.

(9 VAC 5-80-850 and 9 VAC 5-50-260)

24. **HAP Limit Compliance** - Compliance with the Hazardous Air Pollutant (HAPs) limits specified in Condition 23 of this permit shall be determined using a monthly inventory of all HAPs purchased by and/or used on the facility and shall be calculated monthly as the sum of each consecutive 12-month period. These records shall be available on site for inspection by the DEQ and shall be current for the most recent five (5) years.

(9 VAC 5-80-850)

25. **Visible Emission Limit** - Visible emissions from the Woodworking Shop (Building 224) shall not exceed twenty (20) percent opacity except during one six-minute period in any one hour in which visible emissions shall not exceed sixty (60) percent opacity as determined by the EPA Method 9 (reference 40 CFR 60, Appendix A). This condition applies at all times except during startups, shutdowns, and/or malfunctions.

(9 VAC 5-80-850 and 9 VAC 5-40-80)

**26. Fuel** - The distillate fuel oil and the diesel fuel shall meet the specifications listed below:

Maximum sulfur content per shipment:	0.5 %
Maximum sulfur content for NSPS diesel engines:	0.05 %

Beginning October 1, 2010:

Maximum sulfur content for NSPS diesel engines:	0.0015 %
---	----------

(9 VAC 5-80-850, 9 VAC 5-50-260, and 40 CFR 80.510(a) and (b))

**27. Fuel Certification** - The permittee shall obtain a certification from the fuel supplier with each shipment of distillate fuel oil and diesel fuel. Each fuel supplier certification shall include the following:

- a. The name of the fuel supplier;
- b. The date on which the fuel was received;
- c. The quantity of fuel delivered in the shipment;
- d. A statement that the fuel oil complies with American Society for Testing and Materials specifications ASTM D396 for distillate fuel oil numbers 1 and 2 and ASTM D975 for diesel fuel; and
- e. The sulfur content of the distillate fuel oil and the diesel fuel.

Fuel sampling and analysis, independent of that used for certification, as may be periodically required or conducted by the DEQ may be used to determine compliance with the fuel specifications stipulated in Condition 26 of this permit. Exceedance of these specifications may be considered credible evidence of the exceedance of emission limits.

(9 VAC 5-80-850 and 9 VAC 5-80-900)

## **RECORDS**

**28. On Site Records** - The permittee shall maintain records of emission data and operating parameters as necessary to demonstrate compliance with this permit. The content and format of such records shall be arranged with the DEQ Tidewater Regional Office. These records shall include, but are not limited to:

- a. Annual hours of operation for each emergency generator, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- b. Reasons for operation of each designated participating ELRP emergency generator, including documentation of an ELRP declared emergency, normal emergency operation, testing of the unit and/or maintenance.
- c. The base-wide annual throughput of natural gas to the natural gas-fuel burning equipment, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;

- d. The base-wide annual throughput of gasoline to the gasoline storage tanks, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- e. The base-wide annual throughput of jet fuel (JP-8) to the jet fuel storage tanks, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- f. The base-wide annual throughput of coating media, as applied, used in the paint spray booths and designated paint areas (including AMU hangers), calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- g. The base-wide annual throughput of solvents used in the cold solvent parts washers, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- h. The base-wide annual throughput of diesel fuel used in the diesel-powered emergency generator sets and diesel-powered fire suppression pumps, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- i. The base-wide annual throughput of distillate oil used in all distillate oil-fuel burning equipment except for the diesel-powered emergency generator sets and diesel-powered fire pumps, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- j. A yearly inventory of all base-wide Hazardous Air Pollutant (HAP) emissions from all coating processes, fuel storage and transfers, fuel combustion, and jet engine testing, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- k. The annual throughput of dismantled jet engines tested in the jet engine test cells, calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- l. The annual throughput of sawdust material from the wood skills center (woodworking area WW-1), calculated monthly as the sum of each consecutive 12-month period. Compliance for the consecutive 12-month period shall be demonstrated monthly by adding the total for the most recently completed calendar month to the individual monthly totals for the preceding 11 months;
- m. All fuel supplier certifications for the distillate fuel oil and the diesel fuel received;



n. List of the locations of all paint booths, to be current at all times.

These records shall be available for inspection by the DEQ and shall be current for the most recent five (5) years.

(9 VAC 5-80-850)

### **GENERAL CONDITIONS**

**29. Right of Entry** - The permittee shall allow authorized local, state, and federal representatives, upon the presentation of credentials:

- a. To enter upon the permittee's premises on which the facility is located or in which any records are required to be kept under the terms and conditions of this permit;
- b. To have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit or the State Air Pollution Control Board Regulations;
- c. To inspect at reasonable times any facility, equipment, or process subject to the terms and conditions of this permit or the State Air Pollution Control Board Regulations; and
- d. To sample or test at reasonable times.

For purposes of this condition, the time for inspection shall be deemed reasonable during regular business hours or whenever the facility is in operation. Nothing contained herein shall make an inspection time unreasonable during an emergency.

(9 VAC 5-170-130 and 9 VAC 5-80-850)

**30. Notification for Facility or Control Equipment Malfunction** - The permittee shall furnish notification to the DEQ Tidewater Regional Office of malfunctions of the affected facility or related air pollution control equipment that may cause excess emissions for more than one hour, by facsimile transmission, telephone, or e-mail. Such notification shall be made as soon as practicable but no later than four (4) daytime business hours after the malfunction is discovered. The permittee shall provide a written statement giving all pertinent facts, including the estimated duration of the breakdown, within two (2) weeks of discovery of the malfunction. When the condition causing the failure or malfunction has been corrected and the equipment is again in operation, the permittee shall notify the DEQ Tidewater Regional Office in writing.

(9 VAC 5-20-180 C and 9 VAC 5-80-850)

**31. Violation of Ambient Air Quality Standard** - The permittee shall, upon request of the DEQ, reduce the level of operation or shut down a facility that is not mission essential to Langley AFB, as necessary to avoid violating any primary ambient air quality standard and shall not return to normal operation until such time as the ambient air quality standard will not be violated.

(9 VAC 5-20-180 I and 9 VAC 5-80-850)

**APPENDIX A**

Function	Fac#	Rating	Phase	Voltage	Manufacturer	Serial #
OSC	10A	1500	3	277/480	Kohler	5260011581
OSC	10B	1500	3	277/480	Kohler	5262001571
REACH BACK	19	75	3	120/208	Perkins	AH51042/U605592K
480TH IW	23A	1000	3	277/480	Caterpillar	81Z07431
480TH IW	23B	1000	3	277/480	Caterpillar	81Z12920
ACC COMM	25A	600	3	277/480	Caterpillar	VD356883
ACC COMM	25B	750	3	277/480	Caterpillar	1EZ06391
ACC COMM	25C	15	3	120/208	Cummins	0SQ0716
SEW LIFT	56	60	3	120/208	Perkins	U896510F
DINING FACILITY	140	550	3	277/480	Caterpillar	81Z24848
SEW LIFT	251	22	3	120/208	Olympian	U106920D
COMMISSARY	291	300	3	277/480	Caterpillar	1DZ08565
West Gate	296	50	3	120/208	Cummins	46572981
CE COMPLEX	328	500	3	277/480	Caterpillar	81Z25306
LRS/ CAF	330	500	3	277/480	Cummins	79371739
Sent 1 Ops	333	230	3	120/208	Caterpillar	9NR05246
Sentinel II	338	250	3	277/480	Caterpillar	9NR05270
10th IS/MSR	339	230	3	120/208	Caterpillar	9NRO4540
PAINT HANGER	342	8	1	120/240	Generac	Y009
Fire Suppression	348	24.8	3	120/208	Perkins	U221411M
SECURITY POLICE	355	60	3	120/208	Perkins	U524801J
FIRE DEPARTMENT	367	300	3	277/480	Cummins	30315203
Mobility	371	230	3	277/480	Caterpillar	9NR01493
Base Ops (New)	378	300	3	277/480	John Deere	RG6125H035418
AIRFIELD Lighting	379	225	3	277/480	Caterpillar	4ZRO1415
TOWER	381	110	3	120/208	Caterpillar	30A00788
ILS (West)	398	20	1	120/240	Olympian	119278F
Telephone Exchange	407	350	3	120/208	Caterpillar	81Z08244
King St. Gate	408	80	3	120/208	Perkins	U14748IL
Vacuum Station	433	60	3	120/208	Cummins	21836584
AEF CENTER	623	40	3	120/208	Perkins	U914199G
Main Sub Station	632	8	3	120/208	Generac	76895
SEW LIFT	656	30	3	120/208	Cummins	U896512F
HQ ACC	695A	350	3	120/208	Caterpillar	4RG01972
HQ ACC	695B	400	3	277/480	Caterpillar	4RG01969
POL PUMPS	708	300	3	120/208	Perkins	VO61196F
Storm water Drain	719	800	3	277/480	Caterpillar	1EZ04136
LOCALIZER	733	20	1	120/208	Perkins	U119280F
POL DISPATCH	741	60	3	120/208	Olympian	U896048F
Fire Suppression	748	24.8	3	120/208	Perkins	4203553L
1 FW/CP	764A	80	3	120/208	Cummins	46615597
1 FW/CP	764B	100	3	120/208	Cummins	46642497
COMM CTR	768	450	3	277/480	Caterpillar	2WJ00661
ILS (East)	799	20	1	120/240	Olympian	U119295F
AC2 ISRC	801	40	3	120/208	PERKINS	U887929F
Bayview Towers	945	250	3	277/480	Caterpillar	EPS01212
Supply	1017	750	3	277/480	Caterpillar	OESWMJE01572
COMM ITN	1025	300	3	277/480	Caterpillar	1DZ07374
Ammo	1048	100	3	277/481	Kohler	PE6068T638780
MSA Admin	1082	100	3	277/482	Kohler	PE6068H620947
ALERT HANGAR	1362	125	3	240/416	Generac	91A04019-S
ALERT QUARTERS	1363	60	3	120/208	CUMMINS	6BTA5.9-G4
GLIDESLOPE	1365	15	1	120/208	Cummins	5756
SEW LIFT	1371	125	3	120/208	Cummins	73004349
2M Gal Water Tank	1376	600	3	277/480	Generac	KD01053

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## APPENDIX WW

### Acronyms

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Langley Air Force Base  
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### ACRONYMS

<b>AABC</b>	Associated Air Balance Council
<b>AASHTO</b>	American Association of State Highway and Transportation Officials
<b>ABA</b>	Architectural Barriers Act
<b>ACC</b>	Air Combat command
<b>ACS</b>	Access Control System
<b>ADA</b>	Americans With Disabilities Act
<b>ADAAG</b>	American with Disabilities Act Accessibility Guidelines
<b>AFF</b>	Above Finished Floor
<b>AHU</b>	Air Handling Unit
<b>ANSI</b>	The American National Standards Institute
<b>ASHRAE</b>	American Society of Heating, Refrigerating and Air-Conditioning Engineers
<b>ASTM</b>	American Society for Testing and Materials
<b>AT/FP</b>	Anti Terrorism/Force Protection
<b>AWG</b>	American Wire Gauge
<b>AWWA</b>	American Water Works Association -
<b>BACnet</b>	Building Automation and Control Networks
<b>BAS</b>	Building Automation System
<b>BASH</b>	Bird Air Strike Hazard
<b>BBMD</b>	BACnet/IP Broadcast Management Device
<b>BICSI</b>	Building Industry Consulting Services International
<b>BCS</b>	Building Telecommunications Cabling System
<b>BLCC</b>	Building Life Cycle Cost Program
<b>BMP</b>	Best Management Practice
<b>BMS</b>	Balanced Magnetic Switches
<b>CA</b>	Commissioning Authority
<b>CATV</b>	Community Antenna Television
<b>CAV</b>	Constant Air Volume
<b>CCL</b>	Contract Cost Limitation
<b>CCTV</b>	Closed Circuit Television
<b>CFCI</b>	Contractor Furnished Contractor Installed
<b>CID</b>	Comprehensive Interior Design
<b>CoN</b>	Certificate of Networthiness
<b>COR</b>	Contracting Officer's Representative
<b>CRI</b>	Color Rendering Index
<b>DCR</b>	Department of Conservation and Recreation
<b>DIACAP</b>	Department of Defense Information Assurance Certification and Accreditation Process
<b>DDC</b>	Direct Digital Control
<b>EISA</b>	Energy Independence and Security Act
<b>EFIS&amp;T</b>	Electronic Flight Instrument System
<b>EPA</b>	Environmental Protection Agency
<b>EQ</b>	Indoor Environmental Quality
<b>FACP</b>	Fire Alarm Control Panel
<b>FB4P</b>	Federal Biobased Products Preferred Procurement Program

<b>FEMP</b>	Federal Energy Management Program
<b>FF&amp;E</b>	Furniture, Fixtures and Equipment
<b>FO</b>	Fiber Optic
<b>FOD</b>	Foreign Object Debris
<b>FSC</b>	Forest Stewardship Council, Foam System Controls
<b>FSCP</b>	Foam Suppression Control Panel
<b>FSRIA</b>	Farm Security and Rural Investment Act
<b>GBCI</b>	Green Building Certification Institute
<b>GFGI</b>	Government Furnished Government Installed
<b>GOV</b>	Government Owned Vehicle
<b>HEF</b>	High Expansion Foam
<b>HVAC</b>	Heating, Ventilating and Air Conditioning
<b>IAQ</b>	Indoor Air Quality
<b>IDS</b>	Intrusion Detection System
<b>IEEE</b>	Institute of Electrical and Electronics Engineers
<b>IESNA</b>	Illuminating Engineering Society of North America
<b>IMC</b>	International Mechanical Code
<b>LAN</b>	Local Area Network
<b>LCCA</b>	Life Cycle Cost Analysis
<b>LEED</b>	Leadership in Energy and Environmental Design
<b>LEED AP</b>	LEED Accredited Professional
<b>M&amp;C</b>	Monitoring and Controls
<b>MCWB</b>	Mean Coincident Wet Bulb
<b>MNS</b>	Mass Notification System
<b>MR</b>	Materials and Resources
<b>MS/TP</b>	Master-Slave/Token-Passing
<b>N/A</b>	Not Applicable
<b>NEBB</b>	National Environmental Balancing Bureau
<b>NEMA</b>	National Electrical Manufacturers Association
<b>NFPA</b>	National Fire Protection Association
<b>NPDES</b>	National Pollutant Discharge Elimination System
<b>NSR</b>	No Special Requirements
<b>O&amp;M</b>	Operation and Maintenance
<b>OSP</b>	Outside Plant
<b>PET</b>	Protection Entrance Terminals
<b>POV</b>	Privately owned vehicle
<b>PVT</b>	Performance Verification Test
<b>RCDD</b>	Registered Communications Distribution Designer
<b>REC</b>	Renewable Energy Credit
<b>SCIF</b>	Sensitive Compartmented Information Facility
<b>SD&amp;HPGB</b>	Sustainable Design and High Performance Green Building
<b>SD&amp;HPGD</b>	Sustainable Design and High Performance Green Design
<b>SID</b>	Structural Interior Design
<b>SRI</b>	Solar Reflectance Index
<b>SMACNA</b>	Sheet Metal and Air Conditioning Contractor's National Association
<b>SWM</b>	Stormwater Management System
<b>SWPPP</b>	Stormwater Pollution Prevention Plan
<b>TAB</b>	Testing, Adjusting and Balance
<b>TABB</b>	Testing, Adjusting and Balancing Bureau
<b>TEF</b>	Telecommunications Entrance Facility

<b>TVSS</b>	Transient Voltage Surge Suppressor
<b>TW</b>	Thermal-Weather Resistant
<b>UFC</b>	Unified Facilities Criteria
<b>UMCS</b>	Utility Monitoring and Control System
<b>USDA</b>	United States Department of Agriculture
<b>USGBC</b>	United States Green Building Council
<b>UTP</b>	Unshielded Twisted Pair
<b>VAV</b>	Variable Air Volume
<b>VDOT</b>	Virginia Department of Transportation
<b>VNG</b>	Virginia Natural Gas
<b>VSMP</b>	Virginia Stormwater Management Plan

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